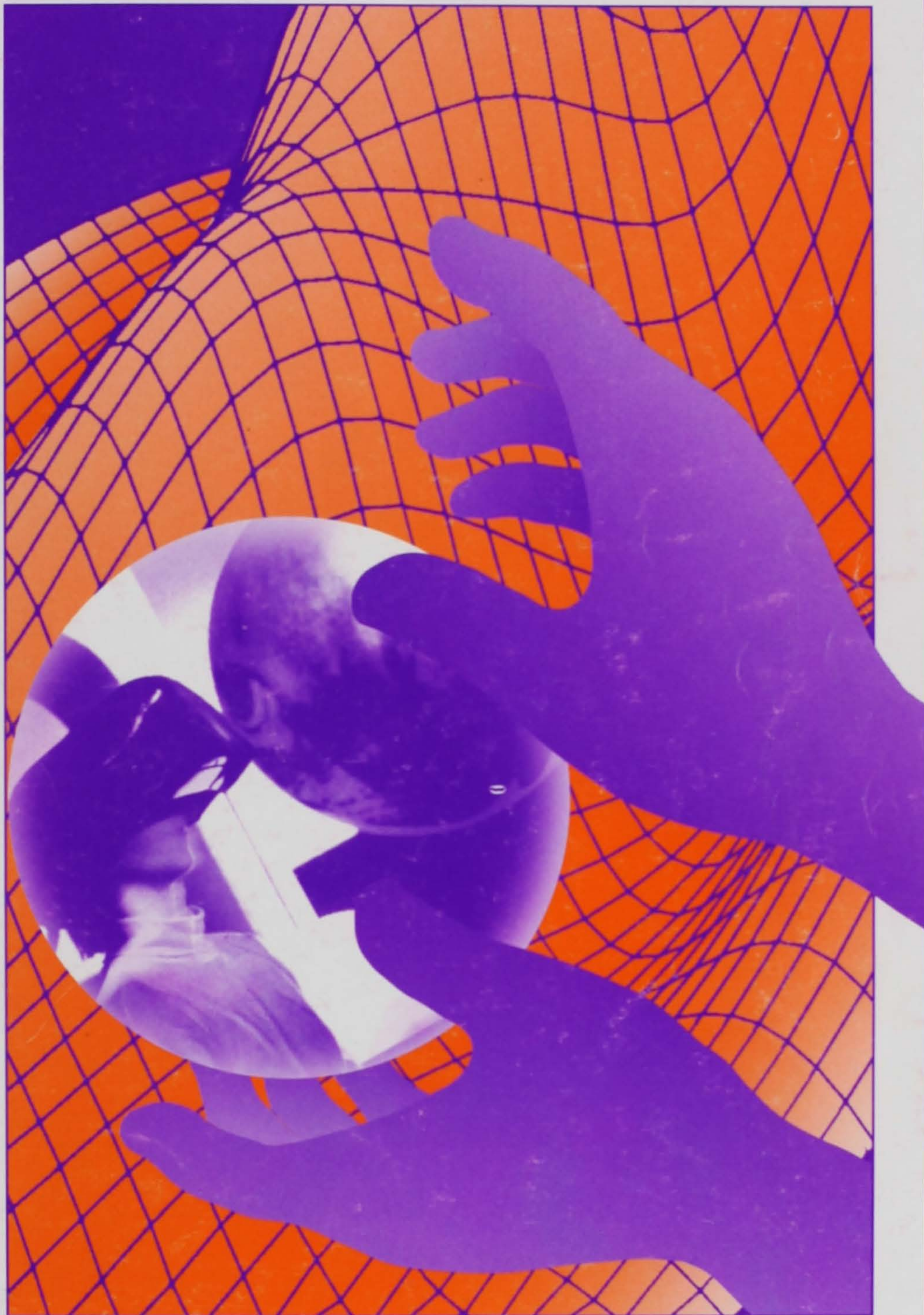


**GRADUATE SCHOOL COURSE OFFERINGS  
1995-96**



**CLEMSON UNIVERSITY**

S. C.  
LD1055  
.C6  
1995/96



## STUDENT RESPONSIBILITY

All colleges and departments establish certain academic requirements that must be met before a degree is granted. Advisors, department heads and deans are available to help the student understand and arrange to meet these requirements, but the student is responsible for fulfilling them. If, at the end of a student's course of study, the requirements for graduation have not been satisfied, the degree will not be granted. For this reason, it is important for each student to acquaint himself or herself with all academic requirements throughout his or her graduate career and to be responsible for completing all such requirements within prescribed deadlines and time limits.

S.C.  
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1995/96

## EQUAL OPPORTUNITY IN PROGRAMS AND ACTIVITIES

Federal laws prohibit discrimination under programs and activities receiving federal financial assistance. The statutes listed below are applicable to Clemson University.

### Title VI of the Civil Rights Act of 1964

"No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance."

### Title IX of the Education Amendments of 1972

"No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance."

### Section 504 of the Rehabilitation Act of 1973

"No otherwise qualified handicapped individual in the United States shall, solely by reason of his handicap, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance."

Clemson University conducts its programs and activities involving admission and treatment of students, employment, teaching, research and public service in a nondiscriminatory manner as prescribed by federal law and regulation.

Inquiries concerning the above may be addressed to:

President  
Clemson University  
Clemson, SC 29634-5002  
or  
Director  
Office for Civil Rights  
Department of Education  
Washington, DC 20201



**Graduate School  
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## DEADLINE DATES

For those who expect to receive a graduate degree on:

|                                                                                                                             | August 12, 1995 | December 21, 1995  | May 10, 1996      | August 10, 1996 |
|-----------------------------------------------------------------------------------------------------------------------------|-----------------|--------------------|-------------------|-----------------|
| <b>Last day for:</b>                                                                                                        |                 |                    |                   |                 |
| Submission of Form GS2, Graduate Degree Curriculum*                                                                         | May 12, 1995    | August 11, 1995    | December 21, 1995 | May 10, 1996    |
| Submission of Form GS4, Application for Graduation and Diploma Order †                                                      | June 12, 1995   | September 13, 1995 | January 30, 1996  | June 10, 1996   |
| Taking of oral and/or written examination                                                                                   | July 21, 1995   | November 30, 1995  | April 19, 1996    | July 19, 1996   |
| Review and approval of completed and signed theses and dissertations by the Graduate School. Duplication requires one week. | July 28, 1995   | December 7, 1995   | April 26, 1996    | July 26, 1996   |
| Submission of duplicated copies of theses and dissertations to the Graduate School Office. Date on Approval Page.           | August 4, 1995  | December 14, 1995  | May 3, 1996       | August 2, 1996  |

\* Although Form GS2 is accepted through the deadline dates listed, students are encouraged to submit this form within the time frame suggested under "Filing of a Graduate Degree Curriculum" in the *Graduate School Announcements*. The filing dates are deadlines for forms carrying all required signatures to be in the Graduate School Office. A \$25 late fee is assessed a student whose form is submitted after the deadline. Beginning the day after the deadline, a \$5 per day fee is added (excluding Saturday, Sunday or University holidays).

† These deadline dates refer to submitting to the Graduate School completed forms and payment of fees directly to the Bursar's Office. A \$25 late fee is assessed a student whose form is submitted after the deadline. Beginning the day after the deadline, a \$5 per day fee is added (excluding Saturday, Sunday or University holidays).



**CONTENTS**

|                                                             |                            |                                                       |                         |
|-------------------------------------------------------------|----------------------------|-------------------------------------------------------|-------------------------|
| STUDENT RESPONSIBILITY .....                                | inside front cover         | COLLEGE OF ENGINEERING AND SCIENCE .....              | 51                      |
| EQUAL OPPORTUNITY IN PROGRAMS<br>AND ACTIVITIES .....       | inside front cover         | School of Chemical and Materials Engineering .....    | 52                      |
| DEADLINE DATES .....                                        | 2                          | Bioengineering .....                                  | M.S., Ph.D. 52          |
| CLEMSON UNIVERSITY CALENDAR .....                           | 4                          | Ceramic Engineering .....                             | M.Engr., M.S., Ph.D. 54 |
| PURPOSE OF THIS PUBLICATION .....                           | 5                          | Chemical Engineering .....                            | M.Engr., M.S., Ph.D. 55 |
| COURSE WORK REQUIREMENTS .....                              | 5                          | Materials Science and Engineering .....               | M.S., Ph.D. 56          |
| Master's Degree .....                                       | 5                          | School of Environmental Engineering and Science ..... | 58                      |
| Specialist in Education Degree .....                        | 5                          | Environmental Science and Policy .....                | Minor 58                |
| Doctor of Philosophy Degree .....                           | 5                          | Environmental Systems                                 |                         |
| Doctor of Education Degree .....                            | 5                          | Engineering .....                                     | M.Engr., M.S., Ph.D. 58 |
| DIRECTORY OF GRADUATE<br>PROGRAM INFORMATION .....          | 6                          | Environmental Toxicology .....                        | M.S., Ph.D. 61          |
| GRADUATE PROGRAMS AND COURSE OFFERINGS .....                | 7                          | Hydrogeology .....                                    | M.S. 61                 |
| Special Courses .....                                       | 7                          | School of Mechanical and Industrial Engineering ..... | 62                      |
| Explanation of Course Listings .....                        | 7                          | Engineering Graphics (no major or minor) .....        | 62                      |
| Course Prefixes .....                                       | 7                          | Engineering Mechanics .....                           | M.S., Ph.D. 62          |
| COLLEGE OF AGRICULTURE, FORESTRY<br>AND LIFE SCIENCES ..... | 9                          | Industrial Engineering .....                          | M.S., Ph.D. 63          |
| Agricultural and Applied Economics .....                    | M.S. 10                    | Mechanical Engineering .....                          | M.Engr., M.S., Ph.D. 65 |
| Community and Rural Development                             |                            | School of Textiles, Fiber and Polymer Science .....   | 68                      |
| (no major or minor) .....                                   | 12                         | Textile and Polymer Science .....                     | Ph.D. 68                |
| Rural Sociology (no major or minor) .....                   | 12                         | Textile Chemistry .....                               | M.S. 68                 |
| Agricultural Education .....                                | M.Ag.Ed. 12                | Textile Science .....                                 | M.S. 68                 |
| Agricultural Engineering .....                              | M.Engr., M.S., Ph.D. 13    | Agricultural Engineering .....                        | M.Engr., M.S., Ph.D. 69 |
| Agricultural Mechanization .....                            | Minor 13                   | Chemistry .....                                       | M.S., Ph.D. 70          |
| Agriculture .....                                           | M.Ag. 14                   | Civil Engineering .....                               | M.Engr., M.S., Ph.D. 72 |
| Integrated Pest Management (no major or minor) .....        | 14                         | Computer Engineering .....                            | M.S., Ph.D. 75          |
| Agronomy .....                                              | M.S., Ph.D. 15             | Computer Science .....                                | M.S., Ph.D. 77          |
| Animal and Food Industries .....                            | M.S. 16                    | Electrical Engineering .....                          | M.Engr., M.S., Ph.D. 80 |
| Animal, Dairy and Veterinary Sciences .....                 | Minor 16                   | Management Science .....                              | Ph.D. 83                |
| Animal Physiology .....                                     | M.S., Ph.D. 17             | Mathematical Sciences .....                           | M.S., Ph.D. 83          |
| Applied Economics .....                                     | Ph.D. 18                   | Physics .....                                         | M.S., Ph.D. 89          |
| Aquaculture, Fisheries and Wildlife Biology .....           | M.S., Ph.D. 19             | Astronomy (no major or minor) .....                   | 91                      |
| Biochemistry .....                                          | M.S., Ph.D. 20             | COLLEGE OF PROFESSIONAL STUDIES .....                 | 93                      |
| Biological Sciences (no major or minor) .....               | 21                         | School of Business .....                              | 94                      |
| Biology (no major or minor) .....                           | 22                         | School of Accountancy and Legal Studies .....         | M.P.Acc. 94             |
| Botany .....                                                | M.S. 22                    | Law (no major or minor) .....                         | 95                      |
| Entomology .....                                            | M.S., Ph.D. 23             | Applied Economics .....                               | Ph.D. 95                |
| Environmental Toxicology .....                              | M.S., Ph.D. 24             | Business Administration .....                         | M.B.A. 95               |
| Experimental Statistics .....                               | Minor 25                   | Economics .....                                       | M.A. 99                 |
| Food Science .....                                          | Minor 26                   | Finance (no major or minor) .....                     | 101                     |
| Food Technology .....                                       | Ph.D. 26                   | Industrial Management .....                           | M.S., Ph.D. 101         |
| Forest Resources .....                                      | M.F.R., M.S., Ph.D. 27     | Management (no major or minor) .....                  | 101                     |
| Genetics .....                                              | M.S., Ph.D. 29             | Hospital Administration (no major or minor) .....     | 104                     |
| Horticulture .....                                          | M.S. 29                    | Management Science .....                              | Ph.D. 104               |
| Microbiology .....                                          | M.S., Ph.D. 30             | Marketing (no major or minor) .....                   | 105                     |
| Nutrition .....                                             | M.S., Ph.D. 32             | School of Education .....                             | 105                     |
| Parks, Recreation and Tourism                               |                            | Administration and Supervision .....                  | M.Ed., Ed.S. 105        |
| Management .....                                            | M.P.R.T.M., M.S., Ph.D. 33 | Counseling and Guidance Services .....                | M.Ed. 105               |
| Plant Pathology .....                                       | M.S., Ph.D. 35             | Curriculum and Instruction .....                      | Ph.D. 105               |
| Plant Physiology .....                                      | Ph.D. 36                   | Elementary Education .....                            | M.Ed. 105               |
| Poultry Science .....                                       | Minor 37                   | Reading .....                                         | M.Ed. 105               |
| Zoology .....                                               | M.S., Ph.D. 37             | Secondary Education .....                             | M.Ed. 105               |
| COLLEGE OF ARCHITECTURE, ARTS<br>AND HUMANITIES .....       | 39                         | Special Education .....                               | M.Ed. 105               |
| Architecture .....                                          | M.Arch., M.S. 40           | Educational Leadership .....                          | Ph.D. 113               |
| City and Regional Planning .....                            | M.C.R.P. 41                | Coaching Education (no major or minor) .....          | 116                     |
| Construction Science and Management .....                   | M.C.S.M. 43                | School of Education .....                             | 116                     |
| English .....                                               | M.A. 44                    | Human Resource Development .....                      | M.H.R.D. 116            |
| Speech (no major or minor) .....                            | 47                         | Industrial Education .....                            | M.In.Ed. 117            |
| History .....                                               | M.A. 47                    | Graphic Communications (no major or minor) .....      | 118                     |
| Geography (no major or minor) .....                         | 48                         | Vocational/Technical Education .....                  | Ed.D. 119               |
| Languages (no major or minor) .....                         | 48                         | School of Health and Social Sciences .....            | 120                     |
| Performing Arts (no major or minor) .....                   | 49                         | Applied Sociology .....                               | M.S. 120                |
| Philosophy and Religion (no major or minor) .....           | 49                         | School of Nursing .....                               | M.S. 121                |
| Professional Communication .....                            | M.A. 49                    | Health (no major or minor) .....                      | 124                     |
| Visual Arts .....                                           | M.F.A. 49                  | Political Science (no major or minor) .....           | 124                     |
| Art and Architectural History (no major or minor) .....     | 50                         | Public Administration .....                           | M.P.A. 124              |
|                                                             |                            | Psychology .....                                      | M.S., Ph.D. 126         |
|                                                             |                            | Public Health .....                                   | 127                     |
|                                                             |                            | Health Administration .....                           | M.H.A. 127              |
|                                                             |                            | DIRECTORY FOR CORRESPONDENCE .....                    | inside back cover       |



# CLEMSON UNIVERSITY CALENDAR

## SUMMER 1995—SUMMER 1996

### First Summer Session 1995

|             |                                                                        |
|-------------|------------------------------------------------------------------------|
| May 22, M   | Walk-through registration                                              |
| May 23, Tu  | Classes begin; late registration fee                                   |
| May 24, W   | Last day to register or add a class                                    |
| May 31, W   | Last day to withdraw from class or the University without record       |
| June 12, M  | Last day to order diploma for August graduation (GS4)                  |
| June 14, W  | Last day to withdraw from class or the University without final grades |
| June 27, Tu | Examinations                                                           |

### Second Summer Session 1995

|              |                                                                        |
|--------------|------------------------------------------------------------------------|
| July 4, Tu   | Holiday                                                                |
| July 5, W    | Orientation                                                            |
| July 6, Th   | Walk-through registration                                              |
| July 7, F    | Classes begin; late registration fee                                   |
| July 8, S    | Classes meet                                                           |
| July 10, M   | Last day to register or add a class                                    |
| July 13, Th  | Last day to withdraw from class or the University without record       |
| July 15, S   | Classes meet                                                           |
| July 27, Th  | Last day to withdraw from class or the University without final grades |
| August 9, W  | Examinations                                                           |
| August 11, F | Last day to submit GS2 for December graduation                         |
| August 12, S | Graduation                                                             |

### Fall Semester 1995

|                      |                                                                        |
|----------------------|------------------------------------------------------------------------|
| August 21, M         | Orientation                                                            |
| August 22, Tu        | Walk-through registration                                              |
| August 23, W         | Late walk-through registration                                         |
| August 24, Th        | Classes begin; late registration fee                                   |
| August 30, W         | Last day to register or add a class                                    |
| September 13, W      | Last day to order diploma for December graduation (GS4)                |
| September 20, W      | Last day to withdraw from class or the University without record       |
| October 23-24, M-Tu  | Fall break                                                             |
| November 1, W        | Last day to withdraw from class or the University without final grades |
| November 13, M       | On-line registration begins                                            |
| November 23-24, Th-F | Thanksgiving holidays                                                  |
| December 11-16, M-S  | Examinations                                                           |
| December 21, Th      | Last day to submit GS2 for May commencement                            |
| December 21, Th      | Graduation                                                             |

### Spring Semester 1996

|                     |                                                                        |
|---------------------|------------------------------------------------------------------------|
| January 8, M        | Orientation; walk-through registration                                 |
| January 9, Tu       | Late walk-through registration                                         |
| January 10, W       | Classes begin; late registration fee                                   |
| January 16, Tu      | Last day to register or add a class                                    |
| January 30, Tu      | Last day to order diploma for May commencement (GS4)                   |
| February 6, Tu      | Last day to withdraw from class or the University without record       |
| March 15, F         | Last day to withdraw from class or the University without final grades |
| March 18-22, M-F    | Spring break                                                           |
| April 7-14, S-S     | Honors and Awards Week                                                 |
| April 8, M          | On-line registration for summer sessions and fall semester begins      |
| April 29-May 4, M-S | Examinations                                                           |
| May 10, F           | Last day to submit GS2 for August graduation                           |
| May 10, F           | Commencement                                                           |

### First Summer Session 1996

|             |                                                                        |
|-------------|------------------------------------------------------------------------|
| May 20, M   | Walk-through registration                                              |
| May 21, Tu  | Classes begin; late registration fee                                   |
| May 22, W   | Last day to register or add a class                                    |
| May 29, W   | Last day to withdraw from class or the University without record       |
| June 10, M  | Last day to order diploma for August graduation (GS4)                  |
| June 12, W  | Last day to withdraw from class or the University without final grades |
| June 25, Tu | Examinations                                                           |

### Second Summer Session 1996

|              |                                                                        |
|--------------|------------------------------------------------------------------------|
| July 1, M    | Orientation                                                            |
| July 2, Tu   | Walk-through registration                                              |
| July 3, W    | Classes begin; late registration fee                                   |
| July 4, Th   | Holiday                                                                |
| July 5, F    | Last day to register or add a class                                    |
| July 6, S    | Classes meet                                                           |
| July 11, Th  | Last day to withdraw from class or the University without record       |
| July 25, Th  | Last day to withdraw from class or the University without final grades |
| August 7, W  | Examinations                                                           |
| August 9, F  | Last day to submit GS2 for December graduation                         |
| August 10, S | Graduation                                                             |



## PURPOSE OF THIS PUBLICATION

The purpose of this publication is to provide prospective graduate students with general information about graduate programs at Clemson University. This includes requirements for application to and completion of the programs, and a listing of the courses and their descriptions for all the programs. More detailed information is available in the *Clemson University Graduate School Announcements*.

A chart of deadlines for various steps in the process of earning a graduate degree and a general calendar for the academic year are included also.

The provisions in this publication are subject to change without notice, and the University reserves the right to make changes as required.

## COURSE WORK REQUIREMENTS

Courses are offered leading to the research degrees of Master of Arts, Master of Science and Doctor of Philosophy.

In addition, courses are offered leading to the professional degrees of Doctor of Education, Specialist in Education, Master of Agricultural Education, Master of Agriculture, Master of Architecture, Master of Business Administration, Master of City and Regional Planning, Master of Construction Science and Management, Master of Education, Master of Engineering, Master of Fine Arts, Master of Forest Resources, Master of Health Administration, Master of Human Resource Development, Master of Industrial Education, Master of Parks, Recreation and Tourism Management, Master of Professional Accountancy, and Master of Public Administration.

### Master's Degree

The total number of graduate credits required for the Master's degree is determined by the student's advisory committee, consistent with the specific program guidelines and Graduate School policy.

The Graduate School requires each degree program to consist of a minimum of 30 semester hours of graduate credit with at least 12 semester hours, exclusive of thesis research credits, in the student's major discipline. A minor, if chosen, shall consist of at least six semester hours in that area. The following conditions, appropriate for the types of degrees, must also be observed:

**1. Master of Arts or Master of Science (Thesis Option).** Each program includes a minimum of 24 semester hours of graduate credit exclusive of thesis research and six semester hours of thesis research (891). At least one-half of the total graduate credit hours, exclusive of thesis research, required by the advisory committee must be selected from courses numbered 800 or above.

**2. Master of Arts or Master of Science (Nonthesis Option).** Each program includes a minimum of 30 semester hours of graduate credit, none of which may be thesis research. At least one-half of the total graduate credit hours required by the advisory committee must be selected from courses numbered 800 or above.

**3. Professional Master's Degrees.** Each program includes a minimum of 30 semester hours of graduate credit. Except for professional programs in the College of Architecture, Arts and Humanities which require a thesis, research credits (891 or 991) may not be included in the program requirements. At least one-half of the total graduate credit hours required by the advisory committee must be selected from courses numbered 700 or above. Any additional requirements for these degrees are described under the colleges which offer the degrees.

Beginning with GS-2 Forms submitted on or after August 12, 1996, there will be an increase in the minimum number of credits required from courses numbered above the 600 level. Master of Arts and Master of Science programs (thesis option) will require at least 18 of

the credit hours to be from 800-level courses; nonthesis master's programs will require at least 21 of the credit hours be from 800-level courses. For professional degrees, the minimum number of credits from courses numbered 700 or above will be the larger of 21 credits or 50 percent of the total credit. These increases do not apply to current approved GS-2 Forms for a specified degree program.

### Specialist in Education Degree

Course work required for the Specialist in Education degree includes 30 semester hours beyond the master's degree to be selected from five areas prescribed by the School of Education. Degree requirements pertaining to residence, time limits and final examinations for professional master's degrees apply to the Specialist in Education degree.

### Doctor of Philosophy Degree

The Doctor of Philosophy degree is not awarded solely on the basis of course work completed; the final basis of granting the degree is the student's grasp of the subject matter of a broad field of study, competency to plan and conduct research, and ability to express himself or herself adequately and professionally in oral and written language.

The advisory committee aids the student in developing a graduate degree curriculum, which includes the selection of specific courses and their sequence. Although no minimum course work requirements exist for the doctoral degree, committees are encouraged to require courses other than those that directly support the dissertation research. Work in the minor field or fields, if required, normally comprises from 12 to 24 hours in courses carrying graduate credit. A minimum of 18 hours of doctoral research is required.

### Doctor of Education Degree

Requirements for the Doctor of Education degree pertaining to residence, time limit, and comprehensive and final examinations are the same as those for the Doctor of Philosophy degree. In addition, the candidate for the Doctor of Education degree must arrange with his or her advisory committee to engage in an internship appropriate to his or her field of professional service.



# DIRECTORY OF GRADUATE PROGRAM INFORMATION

## College of Agriculture, Forestry and Life Sciences

|                                             | Ph.D. | Ed.D. | M.S. | M.A. | Professional Master's | Entrance Examination | Approx. % of full-time degree seekers having assistantships |
|---------------------------------------------|-------|-------|------|------|-----------------------|----------------------|-------------------------------------------------------------|
| Agricultural and Applied Economics          |       |       | ■    |      |                       | 1                    | 67                                                          |
| Agricultural Education                      |       |       |      |      | ■                     |                      | 21                                                          |
| Agricultural Engineering (i)                | ■     |       | ■    |      | ■                     | 1                    | 61                                                          |
| Agriculture                                 |       |       |      |      | ■                     |                      | 14                                                          |
| Agronomy                                    | ■     |       | ■    |      |                       | 1                    | 62                                                          |
| Animal and Food Industries (i)              |       |       | ■    |      |                       | 1                    | 70                                                          |
| Animal, Dairy and Veterinary Sciences       |       |       |      |      |                       |                      |                                                             |
| Food Science                                |       |       |      |      |                       |                      |                                                             |
| Poultry Science                             |       |       |      |      |                       |                      |                                                             |
| Animal Physiology (i)                       | ■     |       | ■    |      |                       | 1                    | 79                                                          |
| Applied Economics (i)                       | ■     |       |      |      |                       | 1                    | 83                                                          |
| Aquaculture, Fisheries and Wildlife Biology | ■     |       | ■    |      |                       | 1                    | 74                                                          |
| Biochemistry                                | ■     |       | ■    |      |                       | 1                    | 55                                                          |
| Botany                                      |       |       | ■    |      |                       | 1                    | 75                                                          |
| Entomology                                  | ■     |       | ■    |      |                       | 1                    | 90                                                          |
| Environmental Toxicology (i)                | ■     |       | ■    |      |                       | 1                    | 89                                                          |
| Food Technology (i)                         | ■     |       |      |      |                       | 1                    | 86                                                          |
| Forest Resources                            | ■     |       | ■    |      | ■                     | 1                    | 64                                                          |
| Genetics (i)                                | ■     |       | ■    |      |                       | 1                    | 72                                                          |
| Horticulture                                |       |       | ■    |      |                       | 1                    | 86                                                          |
| Microbiology                                | ■     |       | ■    |      |                       | 1                    | 65                                                          |
| Nutrition (i)                               | ■     |       | ■    |      |                       | 1                    | 56                                                          |
| Parks, Recreation and Tourism Management    | ■     |       | ■    |      | ■                     | 1                    | 53                                                          |
| Plant Pathology                             | ■     |       | ■    |      |                       | 1                    | 80                                                          |
| Plant Physiology (i)                        | ■     |       |      |      |                       | 1                    | 62                                                          |
| Zoology                                     | ■     |       | ■    |      |                       | 1                    | 73                                                          |

## College of Architecture, Arts and Humanities

|                                     |  |  |   |   |   |   |    |
|-------------------------------------|--|--|---|---|---|---|----|
| Architecture                        |  |  | ■ |   | ■ | 1 | 67 |
| City and Regional Planning          |  |  |   |   | ■ | 1 | 73 |
| Construction Science and Management |  |  |   |   | ■ | 1 | 69 |
| English                             |  |  |   | ■ |   | 1 | 62 |
| History                             |  |  |   | ■ |   | 1 | 43 |
| Professional Communication          |  |  |   | ■ |   | 1 | 42 |
| Visual Arts                         |  |  |   |   | ■ |   | 93 |

## College of Engineering and Science

|                                       |   |  |   |  |   |   |    |
|---------------------------------------|---|--|---|--|---|---|----|
| Agricultural Engineering (i)          | ■ |  | ■ |  | ■ | 1 | 61 |
| Bioengineering                        | ■ |  | ■ |  |   | 1 | 60 |
| Ceramic Engineering                   | ■ |  | ■ |  | ■ | 1 | 63 |
| Chemical Engineering                  | ■ |  | ■ |  | ■ | 1 | 87 |
| Chemistry                             | ■ |  | ■ |  |   | 1 | 84 |
| Civil Engineering                     | ■ |  | ■ |  | ■ | 1 | 59 |
| Computer Engineering                  | ■ |  | ■ |  |   | 1 | 58 |
| Computer Science                      | ■ |  | ■ |  |   | 1 | 57 |
| Electrical Engineering                | ■ |  | ■ |  | ■ | 1 | 61 |
| Engineering Mechanics                 | ■ |  | ■ |  |   | 1 | 79 |
| Environmental Systems Engineering     | ■ |  | ■ |  | ■ | 1 | 67 |
| Hydrogeology                          |   |  | ■ |  |   | 1 | 86 |
| Industrial Engineering                | ■ |  | ■ |  |   | 1 | 32 |
| Materials Science and Engineering (i) | ■ |  | ■ |  |   | 1 | 88 |
| Mathematical Sciences                 | ■ |  | ■ |  |   | 1 | 85 |

|                             |   |  |   |  |   |   |    |
|-----------------------------|---|--|---|--|---|---|----|
| Mechanical Engineering      | ■ |  | ■ |  | ■ | 1 | 66 |
| Physics                     | ■ |  | ■ |  |   | 1 | 80 |
| Textile and Polymer Science | ■ |  |   |  |   | 1 | 92 |
| Textile Chemistry           |   |  | ■ |  |   | 1 | 80 |
| Textile Science             |   |  | ■ |  |   | 1 | 80 |

## College of Professional Studies

|                                  |   |   |   |   |   |        |    |
|----------------------------------|---|---|---|---|---|--------|----|
| Accounting                       |   |   |   |   | ■ | 2      | 32 |
| Administration and Supervision   |   |   |   |   | ■ | 1 or 3 | 1  |
| Applied Economics (i)            | ■ |   |   |   |   | 1      | 83 |
| Applied Sociology                |   |   | ■ |   |   | 1      | 85 |
| Business Administration          |   |   |   |   | ■ | 2      | 5  |
| Counseling and Guidance Services |   |   |   |   | ■ |        | 17 |
| Curriculum and Instruction       | ■ |   |   |   |   | 1      | 31 |
| Economics                        |   |   |   | ■ |   | 1      | 41 |
| Educational Leadership           | ■ |   |   |   |   | 1      | 9  |
| Elementary Education             |   |   |   |   | ■ | 1      | 4  |
| Health Administration            |   |   |   |   | ■ | 1 or 3 |    |
| Human Resource Development       |   |   |   |   | ■ |        | 13 |
| Industrial Education             |   |   |   |   | ■ |        | 34 |
| Industrial Management            | ■ |   | ■ |   |   | 1 or 2 | 68 |
| Management Science (i)           | ■ |   |   |   |   | 1      | 83 |
| Nursing                          |   |   | ■ |   |   | 1      | 9  |
| Psychology                       | ■ |   | ■ |   |   | 1      | 88 |
| Public Administration            |   |   |   |   | ■ | 1      | 15 |
| Reading                          |   |   |   |   | ■ |        | 11 |
| Secondary Education              |   |   |   |   | ■ |        | 8  |
| Special Education                |   |   |   |   | ■ |        | 24 |
| Vocational/Technical Education   |   | ■ |   |   |   | 1      | 11 |

(i) = interdisciplinary program

 1 = GRE  
 2 = GMAT  
 3 = MAT



## GRADUATE PROGRAMS AND COURSE OFFERINGS

### Special Courses

These courses serve special needs for graduate students. They do not count toward a graduate degree, and no letter grades are given.

- G S 799      COMPREHENSIVE STUDIES**  
1-15 cr. (1-15 and 0)  
Independent studies in preparation for comprehensive examinations; credit hours to be determined by the department head or program chair. A letter grade is not given, but satisfactory completion is indicated by a grade of "Credit."
- G S 800      RESEARCH PROPOSAL DEVELOPMENT SEMINAR**  
1 cr. (1 and 0)  
Principles and techniques for the preparation of research proposals. Graded on a credit/no credit basis. Will not count toward a graduate degree.  
**Prerequisite:** Second year or graduate standing in current major.

### Explanation of Course Listings

Programs are listed alphabetically within the college that offers them. In certain departments which offer more than one course sequence, the secondary courses (not leading to a major or a minor) are listed immediately after those normally associated with the degree program or departmental name.

The list of courses offered under each program includes for each course the catalog number, title of course, credit in semester hours, class and laboratory hours per week and, for courses numbered 700 or above, the description of the course. Where courses are offered on a schedule, there is a designation F, S, SS or N following the class and laboratory hours, indicating whether the course is offered in the fall, spring, summer session or as needed. No designation indicates that the course is taught at least every year, but not necessarily during the same term. These designations are projections of the teaching schedules, and many factors can cause a change. It is the responsibility of the student to check with his or her department for verification of the scheduled offerings.

Graduate credit can be earned only for courses numbered 600 or above. Courses listed in this catalog in the 600-699 series are taught concurrently in the same classroom setting as the corresponding 300- and 400-series undergraduate courses. These are described in the general catalog, *Clemson University Undergraduate Announcements 1995-96*, which may be obtained from the director of undergraduate admissions.

Courses numbered in the 300 and 400 sequence are primarily for advanced undergraduates but are offered also for graduate credit when they carry the corresponding 600-level number. 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. Courses numbered 700 or above are restricted to graduate students and certain qualified Clemson University seniors.

Some course listings under certain programs may contain 700-, 800- and 900-level courses with a number, title, credits and hours, but no description. These courses are administered by departments other than the one under which they are listed. In these cases, a note will indicate where the descriptions are located.

A secondary listing of a course in parentheses implies that this course is cross-listed with another program. The course description appears with the parent course only.

The 700-level courses are designed primarily for the degrees that emphasize professional practice rather than research.

### Course Prefixes

This list of course offerings is arranged alphabetically and includes the course prefix used in the Clemson University Graduate School Announcements.

|                                                   |        |
|---------------------------------------------------|--------|
| Accounting .....                                  | ACCT   |
| Agricultural and Applied Economics .....          | AP EC  |
| Agricultural Education .....                      | AG ED  |
| Agricultural Engineering .....                    | AG E   |
| Agricultural Mechanization .....                  | AG M   |
| Agriculture .....                                 | AGRIC  |
| Agronomy .....                                    | AGRON  |
| Animal, Dairy and Veterinary Sciences .....       | ADVSC  |
| Animal Physiology .....                           | AN PH  |
| Applied Psychology .....                          | PSYCH  |
| Applied Sociology .....                           | SOC    |
| Aquaculture, Fisheries and Wildlife Biology ..... | W F B  |
| Architecture .....                                | CA AR  |
| Art and Architectural History .....               | A A H  |
| Astronomy .....                                   | ASTR   |
| Biochemistry .....                                | BIOCH  |
| Bioengineering .....                              | BIO E  |
| Biological Sciences .....                         | BIO SC |
| Biology .....                                     | BIOL   |
| Botany .....                                      | BOT    |
| Business Administration .....                     | M B A  |
| Ceramic Engineering .....                         | CR E   |
| Chemical Engineering .....                        | CH E   |
| Chemistry .....                                   | CH     |
| City and Regional Planning .....                  | C R P  |
| Civil Engineering .....                           | C E    |
| Coaching Education .....                          | C ED   |
| College of Education .....                        | COLED  |
| Community and Rural Development .....             | C R D  |
| Computer Engineering .....                        | E C E  |
| Computer Science .....                            | CP SC  |
| Construction Science and Management .....         | C S M  |
| Economics .....                                   | ECON   |
| Education .....                                   | ED     |
| Educational Leadership .....                      | EDL    |
| Electrical Engineering .....                      | E C E  |
| Engineering Graphics .....                        | E G    |
| Engineering Mechanics .....                       | E M    |
| English .....                                     | ENGL   |
| Entomology .....                                  | ENT    |
| Environmental Science and Policy .....            | EN SP  |
| Environmental Systems Engineering .....           | E S E  |
| Environmental Toxicology .....                    | ENTOX  |
| Experimental Statistics .....                     | EX ST  |
| Finance .....                                     | FIN    |
| Fisheries Biology .....                           | W F B  |
| Food Science .....                                | FD SC  |
| Food Technology .....                             | FD TH  |
| Forest Resources .....                            | FOR    |
| French .....                                      | FR     |
| Genetics .....                                    | GEN    |
| Geography .....                                   | GEOG   |
| Geology .....                                     | GEOL   |
| German .....                                      | GER    |
| Government and International Studies .....        | GINT   |
| Graduate Studies .....                            | G S    |
| Graphic Communications .....                      | G C    |
| Health .....                                      | HLTH   |
| Health Administration .....                       | MHA    |
| History .....                                     | HIST   |
| Horticulture .....                                | HORT   |
| Hospital Administration .....                     | H ADM  |
| Human Resource Development .....                  | H R D  |
| Hydrogeology .....                                | GEOL   |



|                                                |       |
|------------------------------------------------|-------|
| Industrial Education .....                     | IN ED |
| Industrial Engineering .....                   | I E   |
| Industrial Management .....                    | MGT   |
| Industrial/Organizational Psychology .....     | PSYCH |
| Integrated Pest Management .....               | I P M |
| Law .....                                      | LAW   |
| Management .....                               | MGT   |
| Management Science .....                       | MA SC |
| Marketing .....                                | MKT   |
| Materials Science and Engineering .....        | MAT E |
| Mathematical Sciences .....                    | MTHSC |
| Mechanical Engineering .....                   | M E   |
| Microbiology .....                             | MICRO |
| Nursing .....                                  | NURS  |
| Nutrition .....                                | NUTR  |
| Parks, Recreation and Tourism Management ..... | PRTM  |
| Performing Arts .....                          | THEA  |
| Philosophy .....                               | PHIL  |
| Physics .....                                  | PHYS  |
| Plant Pathology .....                          | PL PA |
| Plant Physiology .....                         | PL PH |
| Political Science .....                        | PO SC |
| Poultry Science .....                          | P S   |
| Psychology .....                               | PSYCH |
| Public Administration .....                    | PO SC |
| Religion .....                                 | REL   |
| Rural Sociology .....                          | R S   |
| Sociology .....                                | SOC   |
| Spanish .....                                  | SPAN  |
| Speech .....                                   | SPCH  |
| Textile and Polymer Science .....              | TEXT  |
| Textile Chemistry .....                        | T C   |
| Visual Arts .....                              | ART   |
| Vocational/Technical Education .....           | VT ED |
| Wildlife Biology .....                         | W F B |
| Zoology .....                                  | ZOOL  |



Agricultural and Applied Economics 10

Agricultural Education 12

Agricultural Engineering 13

Agricultural Mechanization 13

Agriculture 14

Agronomy 15

Animal and Food Industries 16

Animal, Dairy and Veterinary Sciences 16

Animal Physiology 17

Applied Economics 18

Aquaculture, Fisheries and Wildlife Biology 19

Biochemistry 20

Biological Sciences 21

Biology 22

Botany 22

Entomology 23

Environmental Toxicology 24

Experimental Statistics 25

Food Science 26

Food Technology 26

Forest Resources 27

Genetics 29

Horticulture 29

Microbiology 30

Nutrition 32

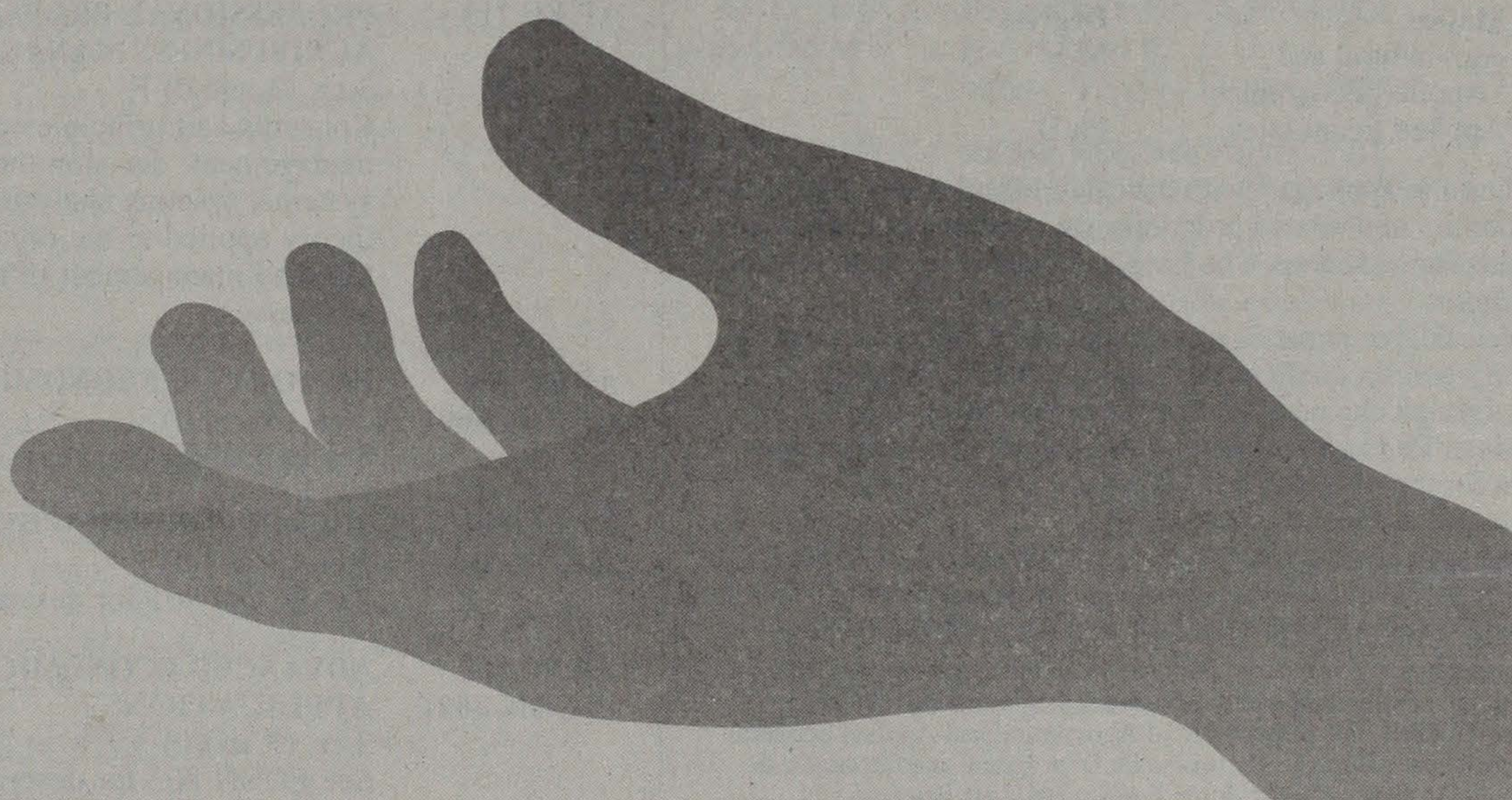
Parks, Recreation and Tourism  
Management 33

Plant Pathology 35

Plant Physiology 36

Poultry Science 37

Zoology 37



# AGRICULTURE, FORESTRY AND LIFE SCIENCES



# COLLEGE OF AGRICULTURE, FORESTRY AND LIFE SCIENCES

T. Ross Wilkinson, Dean, Academic Affairs

The College of Agriculture, Forestry and Life Sciences offers advanced degrees in these areas of study; concentrations within a major area are listed under the degree-granting program.

Agricultural and Applied Economics  
Agricultural Education  
Agricultural Engineering\*  
Agricultural Mechanization  
Agriculture  
Agronomy  
Animal and Food Industries  
Animal, Dairy and Veterinary Sciences  
Food Science  
Poultry Science  
Animal Physiology  
Applied Economics\*\*  
Aquaculture, Fisheries and Wildlife Biology  
Biochemistry  
Botany  
Entomology  
Environmental Toxicology\*\*\*  
Food Technology  
Forest Resources  
Genetics  
Horticulture  
Microbiology  
Nutrition  
Parks, Recreation and Tourism Management  
Plant Pathology  
Plant Physiology  
Zoology

Courses are offered in experimental statistics to provide a minor for students in other areas; and in biological sciences, biology, community and rural development, integrated pest management and rural sociology to provide electives for students in other areas.

## Agricultural and Applied Economics

Garnett L. Bradford, Chair, Department of Agricultural and Applied Economics

| Majors                             | Degrees |
|------------------------------------|---------|
| Agricultural and Applied Economics | M.S.    |
| Applied Economics                  | Ph.D.   |

In addition to applicants with baccalaureate degrees in agricultural economics and related programs, the department encourages applications from students who have a sound background in general economics.

The M.S. degree requires a minimum of 24 credit hours of course work and six credit hours of research. Flexibility is achieved through choice of elective courses and selection of an M.S. thesis or Ph.D. dissertation topic. There is no language requirement for the M.S. or Ph.D. degree.

\* This program is administered jointly by the College of Agriculture, Forestry and Life Sciences and the College of Engineering and Science. The M.S. and Ph.D. degrees are awarded by the College of Engineering and Science.

\*\* This program is a cooperative effort between the Department of Agricultural and Applied Economics and the Department of Economics (College of Professional Studies). The Department of Agricultural and Applied Economics is responsible administratively for the Ph.D. program, and the degree is awarded by the College of Agriculture, Forestry and Life Sciences.

\*\*\* This program is administered jointly by the College of Agriculture, Forestry and Life Sciences and the College of Engineering and Science. The M.S. and Ph.D. degrees are awarded by the College of Agriculture, Forestry and Life Sciences.

|                          |                                                                                                                                                                                                                                                                                                                   |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AP EC 602                | PRODUCTION ECONOMICS<br>3 cr. (3 and 0) F                                                                                                                                                                                                                                                                         |
| AP EC 603                | LAND ECONOMICS<br>3 cr. (3 and 0) S                                                                                                                                                                                                                                                                               |
| AP EC 609                | COMMODITY FUTURES MARKETS<br>3 cr. (3 and 0) F, S                                                                                                                                                                                                                                                                 |
| AP EC 611<br>(C R D 611) | REGIONAL IMPACT ANALYSIS<br>2 cr. (2 and 0) F                                                                                                                                                                                                                                                                     |
| AP EC 612<br>(C R D 612) | SPATIAL COMPETITION AND RURAL DEVELOPMENT<br>3 cr. (3 and 0) S                                                                                                                                                                                                                                                    |
| AP EC 613                | ADVANCED REAL ESTATE APPRAISAL<br>3 cr. (3 and 0) S                                                                                                                                                                                                                                                               |
| AP EC 620                | WORLD AGRICULTURAL TRADE<br>3 cr. (3 and 0) S                                                                                                                                                                                                                                                                     |
| AP EC 625                | AQUACULTURE ECONOMICS<br>3 cr. (3 and 0) F (alternate years)                                                                                                                                                                                                                                                      |
| AP EC 626<br>(AGRON 626) | CROPPING SYSTEMS ANALYSIS<br>3 cr. (2 and 2) F                                                                                                                                                                                                                                                                    |
| AP EC 633                | AGRICULTURAL LAW AND RELATED ENVIRONMENTAL ISSUES<br>3 cr. (3 and 0) S                                                                                                                                                                                                                                            |
| AP EC 652                | AGRICULTURAL POLICY<br>3 cr. (3 and 0) S                                                                                                                                                                                                                                                                          |
| AP EC 656                | PRICES<br>3 cr. (3 and 0) S                                                                                                                                                                                                                                                                                       |
| AP EC 660                | AGRICULTURAL FINANCE<br>3 cr. (3 and 0) S                                                                                                                                                                                                                                                                         |
| AP EC 675                | ECONOMICS OF WILDLIFE MANAGEMENT AND POLICY<br>3 cr. (3 and 0)                                                                                                                                                                                                                                                    |
| AP EC 719                | PROFESSIONAL PROBLEMS IN AGRIBUSINESS MANAGEMENT<br>3 cr. (3 and 0) F<br>Concepts and principles of agribusiness firm management; decision theory, information systems, systems analysis and organization theory applied to the organization, administration and management of agriculturally related businesses. |
| AP EC 800<br>(ECON 800)  | HISTORY OF ECONOMIC THOUGHT<br>3 cr. (3 and 0)<br>See ECON 800 for description.                                                                                                                                                                                                                                   |
| AP EC 801<br>(ECON 801)  | MICROECONOMIC THEORY<br>3 cr. (3 and 0) F<br>See ECON 801 for description.                                                                                                                                                                                                                                        |
| AP EC 802<br>(ECON 802)  | ADVANCED ECONOMIC CONCEPTS AND APPLICATIONS<br>3 cr. (3 and 0)<br>See ECON 802 for description.                                                                                                                                                                                                                   |



- AP EC 804 APPLIED MATHEMATICAL ECONOMICS**  
3 cr. (3 and 0)  
Mathematical tools needed in economic analysis. Topics include matrix algebra, differentiation, unconstrained and constrained optimization, integration and linear programming.
- AP EC 806 ECONOMETRICS I**  
3 cr. (3 and 0)  
Application of econometric techniques and stochastic models to economic problems. Topics include distribution theory, simple and multiple regression modeling, hypothesis testing and other issues in regression analysis.
- AP EC 807 ECONOMETRICS II**  
(ECON 807) 3 cr. (3 and 0) F  
(MA SC 807) See ECON 807 for description.
- AP EC 808 ECONOMETRICS III**  
(ECON 808) 3 cr. (3 and 0) S  
(MA SC 808) See ECON 808 for description.
- AP EC 809 ADVANCED NATURAL RESOURCE ECONOMICS**  
3 cr. (3 and 0) S  
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. **Prerequisite:** AP EC 802 or permission of instructor.
- AP EC 810 NATURAL RESOURCES MANAGEMENT AND POLICY**  
3 cr. (3 and 0) F  
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 not necessary. **Prerequisite:** Permission of instructor.
- AP EC 811 ECONOMICS OF ENVIRONMENTAL QUALITY**  
(ECON 811) 3 cr. (3 and 0) F (even numbered years)  
See ECON 811 for description.
- AP EC 816 LABOR ECONOMICS**  
(ECON 816) 3 cr. (3 and 0)  
See ECON 816 for description.
- AP EC 817 ADVANCED PRODUCTION ECONOMICS**  
3 cr. (3 and 0) S  
Production economics theory in a quantitative framework; technical and economic factor-product, factor-factor and product-product relationships in single- and multiproduct firms under conditions of perfect and imperfect competition in both factor and product markets. **Prerequisite:** AP EC 804 or permission of instructor.
- AP EC 820 PUBLIC FINANCE**  
(ECON 820) 3 cr. (3 and 0)  
See ECON 820 for description.
- AP EC 822 CONTEMPORARY PUBLIC POLICY**  
3 cr. (3 and 0) S  
Contemporary public policy, including price and resource policy, affecting rural areas; public participation, or the lack thereof, related to programs designed to implement public policy.
- AP EC 824 ORGANIZATION OF INDUSTRY**  
(ECON 824) 3 cr. (3 and 0)  
See ECON 824 for description.
- AP EC 826 ECONOMIC THEORY OF GOVERNMENT REGULATION**  
(ECON 826) 3 cr. (3 and 0)  
See ECON 826 for description.
- AP EC 827 ECONOMICS OF PROPERTY RIGHTS**  
(ECON 827) 3 cr. (3 and 0)  
See ECON 827 for description.
- AP EC 828 MARKET STRUCTURE IN AGRICULTURAL INDUSTRIES**  
3 cr. (3 and 0)  
Market structure and other approaches related to agricultural marketing. Individual assignments in the student's field of interest required. **Prerequisite:** Permission of instructor.
- AP EC 831 ECONOMIC DEVELOPMENT**  
(ECON 831) 3 cr. (3 and 0)  
See ECON 831 for description.
- AP EC 832 COMMUNITY AND REGIONAL ECONOMICS**  
3 cr. (3 and 0) F  
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. **Prerequisite:** C R D 612 or permission of instructor.
- AP EC 840 INTERNATIONAL TRADE THEORY**  
(ECON 840) 3 cr. (3 and 0)  
See ECON 840 for description.
- AP EC 841 INTERNATIONAL FINANCE**  
(ECON 841) 3 cr. (3 and 0)  
See ECON 841 for description.
- AP EC 852 RESEARCH METHODS FOR AGRICULTURAL ECONOMISTS I**  
2 cr. (2 and 0) S  
Linear models and their application to problems related to the economics of agriculture. Topics include the simplex method, developing farm planning LP models, solving LP problems using the MPSX computer program, parametric analysis techniques and other LP applications related to rural problems.
- AP EC 855 FINANCIAL ECONOMICS**  
(ECON 855) 3 cr. (3 and 0)  
See ECON 855 for description.



|                                |                                                                                                                                                                                                                                                                                                                                                                         |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>AP EC 881</b>               | <b>INTERNSHIP IN COMMUNITY AND RESOURCE DEVELOPMENT</b><br>1-6 cr.<br>Supervised employment in an agency dealing with socioeconomic aspects, community development and/or natural resource management; monthly reports covering student's experience required. <b>Prerequisite:</b> 18 semester hours of graduate credit.                                               |
| <b>AP EC 888</b><br>(ECON 888) | <b>DIRECTED READINGS IN ECONOMICS</b><br>1-3 cr. (1-3 and 0)<br>See ECON 888 for description.                                                                                                                                                                                                                                                                           |
| <b>AP EC 891</b>               | <b>MASTER'S THESIS RESEARCH</b><br>Credit to be arranged.                                                                                                                                                                                                                                                                                                               |
| <b>AP EC 899</b>               | <b>SELECTED TOPICS IN APPLIED ECONOMICS</b><br>1-3 cr. (1-3 and 0) F, S<br>Students study selected topics under guidance of a professor. Course may be repeated for a maximum of six credits.                                                                                                                                                                           |
| <b>AP EC 901</b><br>(ECON 901) | <b>PRICE THEORY</b><br>3 cr. (3 and 0)<br>See ECON 901 for description.                                                                                                                                                                                                                                                                                                 |
| <b>AP EC 903</b><br>(ECON 903) | <b>GENERAL EQUILIBRIUM AND WELFARE THEORY</b><br>3 cr. (3 and 0) S<br>The second of a two-course sequence of advanced price theory. The first part of this course is the development of the theory of general equilibrium and the economics of welfare; the second is the capital theory and the determination of the rate of interest. <b>Prerequisite:</b> AP EC 901. |
| <b>AP EC 904</b><br>(ECON 904) | <b>SEMINAR IN RESOURCE ECONOMICS</b><br>3 cr. (3 and 0) F<br>Special problems and recent periodical literature relating to the control, management, development and use of land and water resources in the United States and in other parts of the world. <b>Prerequisite:</b> AP EC 403/603.                                                                           |
| <b>AP EC 905</b><br>(ECON 905) | <b>ADVANCED MACROECONOMIC ISSUES</b><br>3 cr. (3 and 0)<br>See ECON 905 for description.                                                                                                                                                                                                                                                                                |
| <b>AP EC 906</b><br>(ECON 906) | <b>SEMINAR IN AREA ECONOMIC DEVELOPMENT</b><br>3 cr. (3 and 0) S<br>Recent research developments in economic development; review of research publications, journal articles and other literature; objectives, analytical techniques and procedures used in area or regional development efforts. <b>Prerequisite:</b> AP EC 806.                                        |
| <b>AP EC 917</b><br>(ECON 917) | <b>ADVANCED SEMINAR IN LABOR ECONOMICS</b><br>3 cr. (3 and 0)<br>See ECON 917 for description.                                                                                                                                                                                                                                                                          |
| <b>AP EC 950</b><br>(ECON 950) | <b>MONETARY ECONOMICS</b><br>3 cr. (3 and 0)<br>See ECON 950 for description.                                                                                                                                                                                                                                                                                           |

|                                 |                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>AP EC 991</b><br>(ECON 991)  | <b>DOCTORAL DISSERTATION RESEARCH</b><br>Credit to be arranged.                                                                                                                                                                                                                                                                                                                      |
| <b>C R D 611</b><br>(AP EC 611) | <b>REGIONAL IMPACT ANALYSIS</b><br>2 cr. (2 and 0) F                                                                                                                                                                                                                                                                                                                                 |
| <b>C R D 612</b><br>(AP EC 612) | <b>SPATIAL COMPETITION AND RURAL DEVELOPMENT</b><br>3 cr. (3 and 0) S                                                                                                                                                                                                                                                                                                                |
| <b>R S 601</b><br>(SOC 601)     | <b>HUMAN ECOLOGY</b><br>3 cr. (3 and 0) S                                                                                                                                                                                                                                                                                                                                            |
| <b>R S 659</b><br>(SOC 659)     | <b>THE COMMUNITY</b><br>3 cr. (3 and 0) F                                                                                                                                                                                                                                                                                                                                            |
| <b>R S 671</b><br>(SOC 671)     | <b>DEMOGRAPHY</b><br>3 cr. (3 and 0) F                                                                                                                                                                                                                                                                                                                                               |
| <b>R S 881</b>                  | <b>SPECIAL PROBLEMS IN RURAL SOCIAL RESEARCH</b><br>1-3 cr. (0 and 2-6)<br>Recent research problems and literature emphasizing research design, analysis, theoretical generalizations and application programs. May be repeated for a maximum of six credits. <b>Prerequisite:</b> Six semester hours of 600-level sociology or rural sociology courses or permission of instructor. |

### Agricultural Education

Lloyd H. Blanton, Acting Chair, Department of Agricultural Education

| Major                  | Degree   |
|------------------------|----------|
| Agricultural Education | M.Ag.Ed. |

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

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

|                  |                                                                                   |
|------------------|-----------------------------------------------------------------------------------|
| <b>AG ED 601</b> | <b>METHODS IN AGRICULTURAL EDUCATION</b><br>3 cr. (2 and 3) F                     |
| <b>AG ED 603</b> | <b>PRINCIPLES OF ADULT/EXTENSION EDUCATION</b><br>3 cr. (3 and 0)                 |
| <b>AG ED 610</b> | <b>HISTORY, PHILOSOPHY AND FUTURE OF THE LAND-GRANT SYSTEM</b><br>3 cr. (3 and 0) |
| <b>AG ED 623</b> | <b>CURRICULUM</b><br>2 cr. (2 and 0) S                                            |
| <b>AG ED 625</b> | <b>TEACHING AGRICULTURAL MECHANICS</b><br>2 cr. (1 and 3) S                       |
| <b>AG ED 628</b> | <b>SPECIAL STUDIES IN AGRICULTURAL EDUCATION</b><br>1-3 cr. (1-3 and 0)           |



- AG ED 631 METHODS IN ENVIRONMENTAL EDUCATION**  
3 cr. (3 and 0) SS
- AG ED 632 VISUAL MEDIA FOR AGRIBUSINESS**  
3 cr. (2 and 3) S
- AG ED 640 PROGRAM DEVELOPMENT IN ADULT/EXTENSION EDUCATION**  
3 cr. (3 and 0)
- AG ED 645 EVALUATION OF ADULT/EXTENSION EDUCATION PROGRAMS**  
3 cr. (3 and 0)
- AG ED 650 MODERN TOPICS AND ISSUES**  
3 cr. (3 and 0)
- AG ED 680 (IN ED 680) (ED 680) (COLED 680) EDUCATIONAL APPLICATIONS OF MICROCOMPUTERS**  
3 cr. (3 and 0)
- AG ED 682 (IN ED 682) (ED 682) (COLED 682) ADVANCED EDUCATIONAL APPLICATIONS OF MICROCOMPUTERS**  
3 cr. (2 and 2)
- AG ED 736 INTERNSHIP: TEACHING**  
3 cr. (1 and 6) S  
Professional competency and program development through classroom and practical experiences in planning, conducting and evaluating educational programs.
- AG ED 737 INTERNSHIP IN AGRIBUSINESS FIRMS**  
3 cr. (1 and 6) SS  
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.
- AG ED 750 SPECIAL INSTITUTE COURSE: SELECTED TOPICS IN AGRICULTURAL EDUCATION**  
1-3 cr. (1-3 and 0)  
Subject areas organized according to institute needs. Topics vary from course to course. May be repeated for a maximum of nine credits.  
**Prerequisite:** Permission of instructor.
- AG ED 801 SYSTEMS FOR TECHNOLOGY TRANSFER**  
3 cr. (3 and 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 803 EVALUATION OF INSTRUCTIONAL PROGRAMS**  
3 cr. (2 and 3) F (odd numbered years)  
Measurement and evaluation in general and as applied to agricultural and vocational education; selection and/or development and use of instruments for appraising educational outcomes of student achievement and total programs. **Prerequisite:** Permission of instructor.

- AG ED 804 SPECIAL PROBLEMS**  
3 cr. (2 and 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 cr. (3 and 0) S (even numbered years)  
Developing a philosophy of education including application of administrative concepts in supervising agricultural education programs.  
**Prerequisite:** Experience in agricultural education.
- AG ED 815 TEACHING AGRICULTURAL AND POWER MECHANICS**  
3 cr. (2 and 3) SS (odd numbered years)  
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.
- AG ED 821 THEORIES AND PRACTICES OF ADULT EDUCATION**  
3 cr. (3 and 0) S  
Recent research on adult learning; a comparison of the assumptions supporting pedagogy and andragogy; emphasis on teaching adults through formal classes and community organizations. **Prerequisite:** PSYCH 201 or ED 302 or equivalent.
- AG ED 869 SEMINAR**  
1-3 cr. (1-3 and 0)  
Students and faculty review current topics in agricultural education.
- AG ED 889 (ED 889) (IN ED 889) RESEARCH IN EDUCATION**  
3 cr. (3 and 0)  
Problem selection; types of educational research and techniques employed; use of ERIC system and computer program packages; interpretation of research findings.

### Agricultural Engineering

Richard O. Hegg, Chair, Department of Agricultural and Biological Engineering

| Major                    | Degrees             |
|--------------------------|---------------------|
| Agricultural Engineering | M.Engr., M.S., Ph.D |

See the College of Engineering and Science for information on this program.

### Agricultural Mechanization

Richard O. Hegg, Chair, Department of Agricultural and Biological Engineering

Advanced degrees are not awarded in agricultural mechanization. Courses are offered as a minor for students majoring in other areas.

- AG M 601 ENVIRONMENTAL CONTROL FOR PLANTS AND ANIMALS**  
1 cr. (1 and 0)



|          |                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AG M 602 | <b>DRAINAGE, IRRIGATION AND WASTE MANAGEMENT</b><br>3 cr. (2 and 3)                                                                                                                                                                                                                                                                                                                                                |
| AG M 603 | <b>STRUCTURES FOR PLANTS AND ANIMALS</b><br>2 cr. (1 and 3)                                                                                                                                                                                                                                                                                                                                                        |
| AG M 606 | <b>MECHANICAL AND HYDRAULIC SYSTEMS</b><br>3 cr. (2 and 3)                                                                                                                                                                                                                                                                                                                                                         |
| AG M 652 | <b>FARM POWER</b><br>3 cr. (2 and 3)                                                                                                                                                                                                                                                                                                                                                                               |
| AG M 660 | <b>FARM AND HOME UTILITIES</b><br>3 cr. (2 and 3)                                                                                                                                                                                                                                                                                                                                                                  |
| AG M 712 | <b>FARM MACHINERY MANAGEMENT</b><br>3 cr. (2 and 3)<br>Selection, functional analysis and maximum utilization of existing and developing farm machinery; computer applications to programming of field operations; available capital and labor; machine size; critical field operations; growing degree days; weather; maintenance equipment, procedures and scheduling.                                           |
| AG M 771 | <b>SELECTED TOPICS IN AGRICULTURAL MECHANIZATION</b><br>1-3 cr. (1-3 and 0)<br>Selected topics not covered in other course offerings; performance measured by oral or written reports or examinations. May be repeated for a maximum of six credits.                                                                                                                                                               |
| AG M 781 | <b>SPECIAL PROBLEMS</b><br>1-3 cr. (1-3 and 0)<br>Independent analysis through literature review and laboratory or field research. Requires written documentation. May be repeated for a maximum of six credits.                                                                                                                                                                                                   |
| AG M 851 | <b>SIMULATION OF AGRICULTURAL SYSTEMS</b><br>3 cr. (3 and 0)<br>Synthesis and analysis of agricultural systems via computer simulation; continuous and discrete systems; philosophy of system simulation and optimization; models are used to teach working techniques, and each student builds a model of a system; computer background not required. <b>Prerequisite:</b> MTHSC 106 or permission of instructor. |

## Agriculture

Jere A. Brittain, Program Coordinator, Department of Horticulture

|              |               |
|--------------|---------------|
| <b>Major</b> | <b>Degree</b> |
| Agriculture  | M.Ag.         |

Applicants to the program are reviewed by a faculty coordinating committee and recommended for admission. Applicants with postbaccalaureate professional experience are required to submit letters of reference, written and oral expressions of professional goals, and have a minimum GPR of 2.5 overall or 2.7 for the last 60 undergraduate hours. Applicants without postbaccalaureate professional experience are required to satisfy the admission criteria for the M.S. degree program.

**Agricultural Economics.** Candidates are required to complete a minimum of 36 hours of course work: 12 hours in an area of special concentration, 12 hours of electives, with at least 12 hours in agricultural economics. Students also must prepare and present an

acceptable professional report in the form of a carefully researched, well-written paper.

**Agricultural Mechanization and Business.** This option requires students to complete 30 semester hours of course work.

**Animal Industries.** Thirty hours of course work are required and are selected specifically to meet the career goals of each student. In addition to the core courses, 12 credit hours of advanced courses relating to animal production and/or processing must be taken.

**Plant Health.** A minimum of 36 semester hours is required, and the student must complete satisfactorily an internship and oral and written examinations.

The core courses listed below are required of all candidates for the Master of Agriculture degree. Descriptions for the 700- and 800-level courses are under the respective departmental headings. Core courses for each option as well as electives are available in the participating departments.

|           |                                                                              |
|-----------|------------------------------------------------------------------------------|
| AP EC 719 | <b>PROFESSIONAL PROBLEMS IN AGRIBUSINESS MANAGEMENT</b><br>3 cr. (3 and 0) F |
| or        | <b>Elective in agricultural and applied economics or business.</b>           |
| AG ED 632 | <b>VISUAL MEDIA FOR AGRIBUSINESS</b><br>3 cr. (2 and 3) S                    |
| or        |                                                                              |
| ENGL 690  | <b>ADVANCED TECHNICAL AND BUSINESS WRITING</b><br>3 cr. (3 and 0)            |
| EX ST 801 | <b>STATISTICAL METHODS</b><br>4 cr. (3 and 3) F, S                           |

*The following courses are required in the plant health option.*

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I P M 601 | <b>PRINCIPLES OF INTEGRATED PEST MANAGEMENT</b><br>3 cr. (2 and 3) F (even numbered years)                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| I P M 700 | <b>INTERNSHIP IN PLANT HEALTH</b><br>1-5 cr. (0 and 8-40)<br>Professional employment under competent supervision in an approved agency or organization dealing with the vocational or occupational aspects of plant health. During the internship, the student will submit weekly reports covering his or her experiences. A terminal report is required also. Graded on a pass/fail basis. <b>Prerequisites:</b> Graduate student standing for at least one semester, I P M 401/601 and permission of the plant health coordinator. |
| I P M 704 | <b>SEMINAR</b><br>1 cr. (1 and 0) F (even numbered years)<br>Students and faculty review current research and development topics in integrated pest management. One or more presentations required. May be repeated for a maximum of two credits. <b>Prerequisite:</b> Permission of instructor.                                                                                                                                                                                                                                     |
| I P M 800 | <b>SPECIAL PROBLEMS IN PLANT HEALTH</b><br>1-3 cr. (0 and 3-9)<br>Directed individual study of a special problem in plant health; emphasis is on organizing, conducting and reporting on independent investigation. <b>Prerequisite:</b> Permission of instructor.                                                                                                                                                                                                                                                                   |



*In addition to the above required courses, the following courses are electives.*

- AGRIC 640 MICROCLIMATOLOGY**  
3 cr. (3 or 0)
- AGRIC 700 SELECTED TOPICS**  
3-6 cr. (0-3 and 0-9)  
Supervised study of a selected area in agricultural science not covered in another course; content varies based on the topic being covered. May be repeated for a maximum of six credits, but only if different topics are covered. **Prerequisite:** Permission of instructor.

## Agronomy

Ralph E. Franklin, Chair, Department of Agronomy and Soils

| Major    | Degrees     |
|----------|-------------|
| Agronomy | M.S., Ph.D. |

The Ph.D. and M.S. (thesis option) are research degrees that require a dissertation and thesis, respectively. The M.S. degree (thesis option) requires 24 credits of course work and six credits of research. The M.S. degree (nonthesis option), a terminal degree for students who do not plan research careers or do not plan to pursue a Ph.D. degree, requires 30 credits of course work.

- AGRON 603 SOIL GENESIS AND CLASSIFICATION**  
2 cr. (1 and 3) F
- AGRON 604 SOILS AND LAND USE**  
2 cr. (1 and 3) F
- AGRON 605 PLANT BREEDING**  
3 cr. (2 and 2) S
- AGRON 607 WEED ECOLOGY AND MANAGEMENT**  
3 cr. (2 and 2) F
- AGRON 608 LAND TREATMENT OF WASTEWATER AND SLUDGES**  
(E S E 608)  
(AG E 608) 3 cr. (3 and 0) F
- AGRON 621 PRINCIPLES OF FIELD CROP PRODUCTION**  
3 cr. (3 and 0) F
- AGRON 622 MAJOR WORLD CROPS**  
3 cr. (3 and 0) S
- AGRON 623 FIELD CROPS—FORAGES**  
3 cr. (3 and 0) S
- AGRON 625 SEED SCIENCE AND TECHNOLOGY**  
3 cr. (2 and 2) S (odd numbered years)
- AGRON 626 CROPPING SYSTEMS ANALYSIS**  
(AP EC 626) 3 cr. (2 and 2) F
- AGRON 633 INTEGRATED WEED MANAGEMENT FOR AGRONOMIC AND HORTICULTURAL CROPS**  
(HORT 633) 3 cr. (2 and 2) S
- AGRON 646 SOIL MANAGEMENT**  
3 cr. (3 and 0) F
- AGRON 652 SOIL FERTILITY AND MANAGEMENT**  
3 cr. (3 and 0) S

- AGRON 653 SOIL FERTILITY LABORATORY**  
1 cr. (0 and 3) S
- AGRON 675 SOIL PHYSICS AND CHEMISTRY**  
3 cr. (2 and 3) S
- AGRON 690 BENEFICIAL SOIL ORGANISMS IN PLANT GROWTH**  
3 cr. (3 and 0) F (odd numbered years)
- AGRON 701 SOILS AND MAN**  
3 cr. (3 and 0)  
Different kinds of soils, their properties, uses, management, conservation and their relationship with the environment and other human endeavors. Not open to agronomy majors pursuing the M.S. or Ph.D. degrees.
- AGRON 801 CROP PHYSIOLOGY AND NUTRITION**  
3 cr. (3 and 0) F (odd numbered years)  
Basic concepts and physiologic aspects of growth and culture applied to crop management practices. **Prerequisites:** BIOSC 401/601 and 402/602 or equivalent.
- AGRON 802 PEDOLOGY**  
3 cr. (3 and 0) F (odd numbered years)  
Current concepts and theories in soil genesis and morphology; advanced study of soil taxonomy. **Prerequisite:** AGRON 403/603.
- AGRON 804 THEORY AND METHODS OF PLANT BREEDING**  
3 cr. (3 and 0) F (even numbered years)  
Concepts and principles of plant breeding and genetics as applied to development and maintenance of improved crop varieties; theoretical considerations of various breeding methods. **Prerequisites:** AGRON 405/605 and EX ST 801 or permission of instructor.
- AGRON 805 SOIL FERTILITY**  
3 cr. (3 and 0) S (even numbered years)  
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. **Prerequisite:** AGRON 452 or 403 or permission of instructor.
- AGRON 806 SPECIAL PROBLEMS**  
1-3 cr. (0 and 3-9)  
Research not related to a thesis.
- AGRON 807 SOIL PHYSICS**  
4 cr. (3 and 3) F (even numbered years)  
Principles and applications of transport of water and solutes in soils emphasizing unsaturated flow phenomenon. **Prerequisite:** MTHSC 108 or equivalent.
- AGRON 808 SOIL CHEMISTRY**  
3 cr. (2 and 3) F (odd numbered years)  
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.



- AGRON 810 SOIL MICROBIOLOGY**  
3 cr. (3 and 0) F (even numbered years)  
Biological nitrogen fixation, mycorrhizal fungi and pesticide interactions in soils with emphasis on microbial-plant-soil relationships. **Prerequisites:** AGRON 690 or MICRO 610 and permission of instructor.
- AGRON 812 CROP ECOLOGY AND LAND USE**  
3 cr. (3 and 0) F (even numbered years)  
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.
- AGRON 820 PESTICIDE RESIDUES IN THE ENVIRONMENT**  
3 cr. (3 and 0) S (odd numbered years)  
Accumulation, decomposition and/or attenuation of pesticides in the environment; pesticide structures and properties; sorption-desorption by soil; diffusion and transport in water; volatility and diffusion in air; chemical-, bio- and photo-degradation. **Prerequisites:** Introductory courses in organic and physical chemistry or permission of instructor.
- AGRON 825 SEMINAR**  
1 cr. (1 and 0) F, S  
Special topics and original research in agronomy. Credit may be earned for more than one semester by doctoral candidates. Graded on a pass/fail basis.
- AGRON 890 SPECIAL TOPICS IN AGRONOMY**  
1-3 cr. (1-3 and 0)  
Group discussion of recent developments in agronomic research. May be repeated for a maximum of six credit hours. **Prerequisite:** Permission of instructor.
- AGRON 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- AGRON 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

### Animal and Food Industries

Charles W. Foley, Chair, Department of Animal, Dairy and Veterinary Sciences

| Major                      | Degree |
|----------------------------|--------|
| Animal and Food Industries | M.S.   |

Students may concentrate in animal science, dairy science, food science or poultry science. See departmental listings in animal, dairy and veterinary sciences; food science; and poultry science for course descriptions. Candidates for the M.S. degree are required to complete a thesis.

### Animal, Dairy and Veterinary Sciences

Charles W. Foley, Chair, Department of Animal, Dairy and Veterinary Sciences

| Majors                     | Degrees     |
|----------------------------|-------------|
| Animal and Food Industries | M.S.        |
| Animal Physiology          | M.S., Ph.D. |
| Nutrition                  | M.S., Ph.D. |

A specific degree is not offered by this department, but the above degrees are granted through interdepartmental, interdisciplinary programs.

- ADVSC 600 DAIRY PROCESSING I**  
4 cr. (3 and 3) S
- ADVSC 601 BEEF PRODUCTION**  
4 cr. (3 and 2) F
- ADVSC 602 DAIRY PROCESSING II**  
4 cr. (3 and 3) F
- ADVSC 603 LABORATORY TECHNIQUES**  
3 cr. (2 and 3) F
- ADVSC 604 DAIRY CATTLE FEEDING AND MANAGEMENT**  
4 cr. (3 and 2) S
- ADVSC 607 EQUINE THERIOGENOLOGY**  
2 cr. (2 and 0) F
- ADVSC 608 PORK PRODUCTION**  
4 cr. (3 and 2) S
- ADVSC 609 SELECTED TOPICS**  
1-3 cr. (1-3 and 0)
- ADVSC 612 HORSE PRODUCTION**  
4 cr. (3 and 2) S
- ADVSC 652 ANIMAL BREEDING**  
3 cr. (3 and 0) S
- ADVSC 653 ANIMAL REPRODUCTION**  
3 cr. (2 and 2) F
- ADVSC 655 ANIMAL REPRODUCTIVE MANAGEMENT**  
1 cr. (0 and 3) S
- ADVSC 661 PHYSIOLOGY OF LACTATION**  
2 cr. (2 and 0) S
- ADVSC 801 SELECTED TOPICS**  
1-3 cr. (1-3 and 0)  
Current topics of special interest in animal, dairy or veterinary sciences not covered in other courses. May be repeated for credit. **Prerequisite:** Permission of coordinating instructor.
- ADVSC 802 MEAT TECHNOLOGY**  
3 cr. (3 and 0)  
Biochemistry, histology and microbiology of fresh, frozen, cured, smoked and processed meats; quality of meats and meat products, processing methods, nutritive value and research techniques. **Prerequisites:** ADVSC 253 and 255.



**ADVSC 803 PHYSIOLOGY OF REPRODUCTION AND MILK SECRETION**  
3 cr. (3 and 0)  
Development of 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. **Prerequisites:** ADVSC 453 and 461 or permission of instructor.

**ADVSC 804 METHODS IN ANIMAL BREEDING**  
3 cr. (3 and 0)  
Gene and zygotic frequency; system of mating; heritabilities; genetic consequences of selection; and criteria for evaluating improvement in all domestic livestock. **Prerequisite:** ADVSC 452/652.

**ADVSC 820 ANIMAL, DAIRY AND VETERINARY SCIENCES GRADUATE SEMINAR**  
1 cr. (1 and 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. **Prerequisite:** Graduate standing.

**ADVSC 822 SPECIAL PROBLEMS**  
1-3 cr. (0 and 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. **Prerequisite:** Permission of instructor supervising study.

**ADVSC 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.

## Animal Physiology

John R. Diehl, Program Coordinator, Department of Animal, Dairy and Veterinary Sciences

| Major             | Degrees     |
|-------------------|-------------|
| Animal Physiology | M.S., Ph.D. |

Animal physiology is an interdepartmental graduate program. Applicants should have a strong background in the biological and physical sciences.

Students enrolled in the M.S. program are required to complete AN PH 660, BIOCH 623, EX ST 801 and BIOSC 659 and 660, except as waived by the student's graduate advisory committee if equivalent courses have been taken already. Additional course work may be taken in areas of the student's interest as approved by the graduate advisory committee. A thesis is required.

The Ph.D. degree does not have formal course work requirements, but it is recognized that students will have individual deficiencies. Therefore, it is the responsibility of the student and his or her major advisor, in consultation with the graduate advisory committee, to prescribe course work to correct these deficiencies. All students majoring in animal physiology are required to complete AN PH 851.

**AN PH 660 SYSTEMS PHYSIOLOGY**  
1 cr. (1 and 0) F

**AN PH 801 (BIOSC 801) ELECTRON MICROSCOPY OF BIOLOGICAL SPECIMENS**  
3 cr. (1 and 6) F, S  
Concepts and practice in preparing biological specimens for electron microscopy: fixing, embedding, thin-sectioning, staining, operating microscopes and photographing, developing, printing and interpreting micrographs. Each student must achieve proficiency with a selected specimen, including writing a brief research proposal, preparing specimen, studying specimen with electron microscope and interpreting micrographs. **Prerequisite:** Permission of instructor.

**AN PH 802 SELECTED TOPICS**  
1-3 cr. (1-3 and 0-3) F, S  
Current topics of special interest in animal physiology not covered in other courses. May be repeated for a maximum of six credits. **Prerequisite:** Permission of instructor.

**AN PH 806 CARE AND USE OF RESEARCH ANIMALS**  
3 cr. (1 and 6) F  
Demonstration and practice of humane use and care of animals in research; study of pain, analgesia and anesthesia; regulatory aspects of the use of animals in teaching and research; surgical techniques and sample collection. **Prerequisites:** BIOSC 459/659 and AN PH 460/660 or permission of instructor.

**AN PH 807 SPECIAL PROBLEMS IN ANIMAL PHYSIOLOGY**  
1-3 cr. (1-3 and 0)  
Research not related to a thesis. May include a comprehensive review of related literature.

**AN PH 808 CURRENT CONCEPTS IN ENDOCRINOLOGY**  
3 cr. (3 and 0) S  
Advanced concepts relevant to interrelationships between the nervous and endocrine systems as they influence growth and development, body metabolism and regulatory mechanisms, reproduction and lactation. **Prerequisites:** AN PH 660 and BIOSC 680, or BIOCH 817, or permission of coordinator.

**AN PH 812 DIGESTIVE-METABOLIC, EXCRETORY AND RESPIRATORY PHYSIOLOGY**  
5 cr. (4 and 3) F (even numbered years)  
Development of advanced concepts of mechanisms and functions of 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. **Prerequisites:** BIOSC 659 and AN PH 660 or permission of course coordinator.



- AN PH 814** **MEMBRANE, CARDIOVASCULAR AND NEUROMUSCULAR PHYSIOLOGY**  
5 cr. (4 and 3) S (even numbered years)  
Development of advanced concepts in membrane physiology (permeability, action potentials, specialized functions), cardiovascular physiology (functions of the heart, blood-vascular system in maintaining acid-base balance, clotting mechanisms, homeostasis, circulation), neuromuscular physiology (anatomy and function of the nervous system, special senses, reflexes, control of muscular activity); and the action of several pharmacologic agents on muscle and nerve functions. **Prerequisites:** BIOSC 659 and AN PH 660 or permission of course coordinator.
- AN PH 851** **ANIMAL PHYSIOLOGY SEMINAR**  
1 cr. (1 and 0) F, S  
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**  
Credit to be arranged.
- AN PH 991** **DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

*The following courses offered by various departments represent possible electives for the student in animal physiology. Descriptions for all 800-level courses are under the respective departmental headings.*

- ADVSC 653** **ANIMAL REPRODUCTION**  
3 cr. (2 and 2) F
- ADVSC 655** **ANIMAL REPRODUCTIVE MANAGEMENT**  
1 cr. (0 and 3) S
- ADVSC 661** **PHYSIOLOGY OF LACTATION**  
2 cr. (2 and 0) S
- ADVSC 803** **PHYSIOLOGY OF REPRODUCTION AND MILK SECRETION**  
3 cr. (3 and 0)
- BIOCH 606** **PHYSIOLOGICAL CHEMISTRY**  
3 cr. (3 and 0)
- BIOCH 623** **PRINCIPLES OF BIOCHEMISTRY**  
3 cr. (3 and 0)
- BIOCH 633** **GENERAL BIOCHEMISTRY LABORATORY I**  
2 cr. (0 and 4)
- BIOCH 634** **GENERAL BIOCHEMISTRY LABORATORY II**  
2 cr. (0 and 4)
- BIOCH 815** **LIPIDS AND BIOMEMBRANES**  
3 cr. (3 and 0)
- BIOCH 817** **CHEMISTRY AND METABOLISM OF HORMONES**  
3 cr. (3 and 0)
- BIOSC 632** **ANIMAL HISTOLOGY**  
3 cr. (3 and 0)

- BIOSC 633** **ANIMAL HISTOLOGY LABORATORY**  
2 cr. (1 and 2)
- BIOSC 659** **SYSTEMS PHYSIOLOGY**  
3 cr. (3 and 0)
- BIOSC 660** **SYSTEMS PHYSIOLOGY LABORATORY**  
2 cr. (1 and 2)
- BIOSC 661** **CELL BIOLOGY**  
3 cr. (3 and 0)
- BIOSC 670** **ANIMAL BEHAVIOR**  
3 cr. (3 and 0)
- BIOSC 671** **ANIMAL BEHAVIOR LABORATORY**  
1 cr. (0 and 3)
- BIOSC 675** **COMPARATIVE PHYSIOLOGY**  
3 cr. (3 and 0)
- BIOSC 676** **COMPARATIVE PHYSIOLOGY LABORATORY**  
2 cr. (1 and 2)
- BIOSC 680** **VERTEBRATE ENDOCRINOLOGY**  
3 cr. (3 and 0)
- ENT 640** **INSECT BEHAVIOR**  
3 cr. (2 and 3)
- ENT 670** **INSECT PHYSIOLOGY**  
3 cr. (2 and 3)
- EX ST 801** **STATISTICAL METHODS**  
4 cr. (3 and 3) F, S
- EX ST 803** **REGRESSION AND LEAST SQUARES ANALYSIS**  
3 cr. (3 and 0) F
- EX ST 805** **DESIGN AND ANALYSIS OF EXPERIMENTS**  
3 cr. (3 and 0) F, S
- MICRO 614** **BASIC IMMUNOLOGY**  
3 cr. (2 and 3) F
- MICRO 811** **BACTERIAL CYTOLOGY AND PHYSIOLOGY**  
4 cr. (4 and 0) S (odd numbered years)
- P S 600** **AVIAN PHYSIOLOGY**  
3 cr. (3 and 0) S (even numbered years)
- P S 825** **IMMUNOBIOLOGY**  
3 cr. (3 and 0) S

### Applied Economics

Garnett L. Bradford, Chair, Department of Agricultural and Applied Economics

| Major             | Degree |
|-------------------|--------|
| Applied Economics | Ph.D.  |

The graduate program in applied economics utilizes the facilities and faculty of the Department of Agricultural and Applied Economics and the Department of Economics in the College of Professional Studies. Students may carry out their dissertation research under the direction of a faculty member from either department.



**Aquaculture, Fisheries and Wildlife Biology**

D. Lamar Robinette, Chair, Department of Aquaculture, Fisheries and Wildlife

| Major                                          | Degree      |
|------------------------------------------------|-------------|
| Aquaculture, Fisheries<br>and Wildlife Biology | M.S., Ph.D. |

Students desiring to pursue graduate work in aquaculture, fisheries and wildlife biology should have sound undergraduate training in the biological or related sciences.

Twenty-four semester hours of course work approved by the student's advisory committee, six credit hours of research (W F B 891), an acceptable thesis based upon original research and satisfactory performance in a final oral examination are required.

|                        |                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| W F B 612              | <b>WILDLIFE MANAGEMENT</b><br>3 cr. (2 and 3) S                                                                                                                                                                                                                                                                                                                                                             |
| W F B 614              | <b>WILDLIFE NUTRITIONAL ECOLOGY</b><br>3 cr. (3 and 0) N                                                                                                                                                                                                                                                                                                                                                    |
| W F B 616              | <b>FISHERY BIOLOGY</b><br>3 cr. (2 and 3) F                                                                                                                                                                                                                                                                                                                                                                 |
| WFB 630                | <b>WILDLIFE CONSERVATION POLICY</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                      |
| W F B 650              | <b>AQUACULTURE</b><br>3 cr. (3 and 0) S                                                                                                                                                                                                                                                                                                                                                                     |
| W F B 651              | <b>FISH HATCHERY MANAGEMENT</b><br>3 cr. (3 and 0) F                                                                                                                                                                                                                                                                                                                                                        |
| W F B 652              | <b>FISH PHYSIOLOGY</b><br>4 cr. (3 and 3)                                                                                                                                                                                                                                                                                                                                                                   |
| W F B 660              | <b>WARMWATER FISH DISEASES</b><br>2 cr. (2 and 0) SS (even numbered years)                                                                                                                                                                                                                                                                                                                                  |
| W F B 662              | <b>WETLAND WILDLIFE BIOLOGY</b><br>3 cr. (3 and 0) F                                                                                                                                                                                                                                                                                                                                                        |
| W F B 669<br>(ENT 669) | <b>AQUATIC INSECTS</b><br>3 cr. (1 and 6) S (odd numbered years)                                                                                                                                                                                                                                                                                                                                            |
| W F B 712              | <b>WILDLIFE CONSERVATION FOR TEACHERS</b><br>2-3 cr. (2-3 and 0)<br>Principles and practices of wildlife conservation providing an overview of wildlife diversity, ecology and management in the state. Topics include population census, wildlife identification, capture and habitat management of game and nongame species. For in-service teachers only. <b>Prerequisite:</b> Permission of instructor. |
| W F B 716              | <b>BIOLOGY OF FISHES FOR TEACHERS</b><br>3 cr. (3 and 0) SS<br>Biology of fishes for in-service science teachers; an overview of fish diversity, ecology, conservation and management. <b>Prerequisite:</b> Permission of instructor.                                                                                                                                                                       |
| W F B 809              | <b>SEMINAR IN WILDLIFE AND FISHERIES SCIENCE</b><br>1 cr. (1 and 0) S<br>Current literature and research in fisheries and wildlife sciences; one or more presentations required. May be repeated for a maximum of four credits.                                                                                                                                                                             |

**W F B 810****PUBLISHING IN NATURAL RESOURCE JOURNALS**

2 cr. (2 and 0) S (odd numbered years)  
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.

**W F B 812****CONSERVATION AND ECOLOGY OF ENDANGERED SPECIES**

3 cr. (3 and 0) F (even numbered years)  
Exploration of the processes by which species become endangered or extinct; state, federal and international strategies for species recovery. Students write a species recovery plan. **Prerequisite:** Graduate standing in a life science major or permission of instructor.

**W F B 813****CONSERVATION AND ECOLOGY OF WILDLIFE IN THE TROPICS**

3 cr. (3 and 0) N  
Tropical ecosystems, emphasizing the ecology and conservation of wildlife species in the neotropics; special problems associated with tropical conservation. **Prerequisite:** BIOSC 441 or equivalent.

**W F B 815****PRINCIPLES OF WILDLIFE BIOLOGY**

3 cr. (2 and 3) F (even numbered years)  
Theories and principles applicable to wildlife biology emphasizing upland game species.

**W F B 816****APPLIED WILDLIFE BIOLOGY**

3 cr. (2 and 3) S (even numbered years)  
Techniques and practices involved in management of wildlife species emphasizing upland game.

**W F B 818****WATERFOWL ECOLOGY AND MANAGEMENT**

3 cr. (2 and 3) F (odd numbered years)  
Identification, ecology and management of waterfowl; laboratory work includes demonstration and application of relevant waterfowl management techniques, current literature topics and field trips. **Prerequisite:** BIOSC 441/641 or W F B 412/612 or permission of instructor.

**W F B 820****SEMINAR IN AVIAN ECOLOGY**

1 cr. (1 and 0) N  
Current issues in avian ecology; students read extensively from recent literature in avian ecology and are responsible for leading and participating in discussions of current research. May be repeated for credit. **Prerequisite:** Graduate standing in a life science or related course of study.

**W F B 830****ESTIMATION OF ANIMAL POPULATION PARAMETERS**

3 cr. (2 and 3) S  
Techniques for sampling and estimation of parameters of free-ranging fish and wildlife populations, such as size, density, survival, natality and movement patterns; underlying assumptions, statistical properties and proper interpretation of contemporary quantitative methodology. **Prerequisite:** EX ST 801.



- W F B 840 FISH MANAGEMENT**  
3 cr. (2 and 3) F (odd numbered years)  
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. **Prerequisite:** W F B 416/616 or ZOOL 463/663 or permission of instructor.
- W F B 860 DIAGNOSTIC PROCEDURES OF WARMWATER FISH DISEASES**  
2 cr. (1 and 2) SS (odd numbered years)  
Study of warmwater fish disease diagnostic procedures employing proper protocol and procedures to be followed by a fish disease diagnostician. **Corequisite:** W F B 460/660 or permission of instructor.
- W F B 861 SELECTED TOPICS**  
1-4 cr. (1-4 and 0)  
Current areas of aquaculture, fisheries and wildlife management and research. May be repeated for credit. **Prerequisite:** Permission of instructor.
- W F B 863 SPECIAL PROBLEMS IN WILDLIFE AND FISHERIES BIOLOGY**  
1-3 cr. (0 and 3-9)  
Research not related to a thesis. Credit varies with problems selected. **Prerequisite:** Permission of instructor.
- W F B 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- W F B 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

## Biochemistry

Richard H. Hilderman, Program Coordinator, Department of Biological Sciences

Major  
Biochemistry

Degrees  
M.S., Ph.D.

Enrollment in the biochemistry 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.

Attendance and participation in departmental seminars are mandatory for all graduate students.

In addition to 10 credit hours of core courses, the M.S. degree requires a minimum of 14 credit hours of course work; 12 of the 14 credits must be in 800-level courses. A minimum of six semester hours of M.S. research, culminating in a thesis, is required.

The Ph.D. degree requires, in addition to the core courses, three of the four courses: BIOCH 815, 822, 831 and 841. Successful completion of written and oral comprehensive examinations (before six semesters in residence) will admit the student to candidacy for the Ph.D. degree.

- BIOCH 606 PHYSIOLOGICAL CHEMISTRY**  
3 cr. (3 and 0)
- BIOCH 623 PRINCIPLES OF BIOCHEMISTRY**  
3 cr. (3 and 0)

- BIOCH 631 A PHYSICAL APPROACH TO BIOCHEMISTRY**  
3 cr. (3 and 0)
- BIOCH 632 BIOCHEMISTRY OF METABOLISM**  
3 cr. (3 and 0)
- BIOCH 633 GENERAL BIOCHEMISTRY LABORATORY I**  
2 cr. (0 and 4)
- BIOCH 634 GENERAL BIOCHEMISTRY LABORATORY II**  
2 cr. (0 and 4)
- BIOCH 815 LIPIDS AND BIOMEMBRANES**  
3 cr. (3 and 0)  
Isolation, chemical and physical properties and metabolism of lipids; purification, structure, function and biosynthesis of biomembranes. **Prerequisite:** BIOCH 432/632 or permission of instructor.
- BIOCH 817 CHEMISTRY AND METABOLISM OF HORMONES**  
3 cr. (3 and 0)  
Isolation, assay and chemistry of the various hormones; hormonal control of metabolism and body functions; endocrinopathies of hormone imbalance. **Prerequisite:** BIOCH 432/632 or permission of instructor.
- BIOCH 821 PROTEINS**  
3 cr. (3 and 0)  
Isolation, composition, structure and properties of proteins; methods of isolation, analysis and characterization; properties of "unusual" protein systems. **Prerequisite:** BIOCH 431/631 or 423/623 or permission of instructor.
- BIOCH 822 ENZYMES**  
3 cr. (3 and 0)  
Kinetics, mechanisms of action, inhibitions and general properties of enzymes. **Prerequisite:** BIOCH 431/631 or 423/623.
- BIOCH 831 PHYSICAL BIOCHEMISTRY**  
3 cr. (3 and 0)  
Description and theory of physical methods and instrumentation used in analysis of biological macromolecules. **Prerequisites:** BIOCH 431/631 or 423/623, and one semester of physical chemistry or permission of instructor.
- BIOCH 841 BIOCHEMICAL GENETICS**  
3 cr. (3 and 0)  
Regulation of replication and transcription; students present papers from recent literature and write a research proposal. **Prerequisite:** One year of biochemistry or permission of instructor.
- BIOCH 851 BIOCHEMISTRY SEMINAR**  
1 cr. (1 and 0)  
Students review current topics in biochemistry.
- BIOCH 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- BIOCH 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.



**Biological Sciences**

James K. Zimmerman, Chair, Department of Biological Sciences

Advanced degrees are not awarded in biological sciences as a major. These courses are taught by faculty in the Department of Biological Sciences to supplement courses and graduate degrees awarded in biochemistry, botany, genetics and zoology.

|                                              |                                                                           |                                 |                                                                                                                  |
|----------------------------------------------|---------------------------------------------------------------------------|---------------------------------|------------------------------------------------------------------------------------------------------------------|
| <b>BIOSC 601</b>                             | <b>PLANT PHYSIOLOGY</b><br>3 cr. (3 and 0)                                | <b>BIOSC 643</b>                | <b>AQUATIC ECOLOGY</b><br>3 cr. (3 and 0)                                                                        |
| <b>BIOSC 602</b>                             | <b>PLANT PHYSIOLOGY LABORATORY</b><br>1 cr. (0 and 3)                     | <b>BIOSC 645</b>                | <b>ECOLOGY LABORATORY</b><br>2 cr. (1 and 2)                                                                     |
| <b>BIOSC 603</b>                             | <b>PROTOZOOLOGY</b><br>3 cr. (3 and 0)                                    | <b>BIOSC 646</b>                | <b>PLANT ECOLOGY</b><br>3 cr. (3 and 0)                                                                          |
| <b>BIOSC 604</b>                             | <b>PROTOZOOLOGY LABORATORY</b><br>2 cr. (1 and 2)                         | <b>BIOSC 647</b>                | <b>PLANT ECOLOGY LABORATORY</b><br>2 cr. (1 and 2)                                                               |
| <b>BIOSC 605</b>                             | <b>MOLECULAR GENETICS OF EUKARYOTES</b><br>3 cr. (3 and 0)                | <b>BIOSC 650</b>                | <b>DEVELOPMENTAL BIOLOGY<br/>LABORATORY</b><br>2 cr. (1 and 2)                                                   |
| <b>BIOSC 606</b>                             | <b>INTRODUCTORY PLANT TAXONOMY</b><br>3 cr. (3 and 0)                     | <b>BIOSC 652</b>                | <b>PLANT ANATOMY AND MORPHOLOGY</b><br>3 cr. (3 and 0)                                                           |
| <b>BIOSC 607</b>                             | <b>PLANT TAXONOMY LABORATORY</b><br>1 cr. (0 and 3)                       | <b>BIOSC 653</b>                | <b>PLANT ANATOMY AND MORPHOLOGY<br/>LABORATORY</b><br>2 cr. (1 and 2)                                            |
| <b>BIOSC 610</b>                             | <b>LIMNOLOGY</b><br>3 cr. (3 and 0)                                       | <b>BIOSC 656</b>                | <b>MEDICAL AND VETERINARY<br/>PARASITOLOGY</b><br>3 cr. (3 and 0)                                                |
| <b>BIOSC 611</b>                             | <b>LIMNOLOGICAL ANALYSES</b><br>2 cr. (1 and 2)                           | <b>BIOSC 657</b>                | <b>MEDICAL AND VETERINARY<br/>PARASITOLOGY LABORATORY</b><br>2 cr. (1 and 2)                                     |
| <b>BIOSC 616</b><br>(GEN 616)                | <b>RECOMBINANT DNA</b><br>3 cr. (3 and 0)                                 | <b>BIOSC 658</b><br>(AG E 658)  | <b>CELL PHYSIOLOGY</b><br>3 cr. (3 and 0)                                                                        |
| <b>BIOSC 618</b><br>(MICRO 618)<br>(GEN 618) | <b>BIOTECHNOLOGY I: NUCLEIC ACIDS<br/>TECHNIQUES</b><br>4 cr. (2 and 4) N | <b>BIOSC 659</b>                | <b>SYSTEMS PHYSIOLOGY</b><br>3 cr. (3 and 0)                                                                     |
| <b>BIOSC 620</b>                             | <b>NEUROBIOLOGY</b><br>3 cr. (3 and 0)                                    | <b>BIOSC 660</b>                | <b>SYSTEMS PHYSIOLOGY LABORATORY</b><br>2 cr. (1 and 2)                                                          |
| <b>BIOSC 625</b>                             | <b>INTRODUCTORY MYCOLOGY</b><br>3 cr. (3 and 0)                           | <b>BIOSC 661</b>                | <b>CELL BIOLOGY</b><br>3 cr. (3 and 0)                                                                           |
| <b>BIOSC 626</b>                             | <b>MYCOLOGY PRACTICUM</b><br>2 cr. (1 and 2)                              | <b>BIOSC 662</b>                | <b>CELL BIOLOGY LABORATORY</b><br>2 cr. (1 and 2)                                                                |
| <b>BIOSC 630</b><br>(AG E 630)               | <b>ENGINEERING MODELING OF<br/>BIOLOGICAL SYSTEMS</b><br>3 cr. (3 and 0)  | <b>BIOSC 664</b>                | <b>MAMMALOGY</b><br>3 cr. (2 and 3)                                                                              |
| <b>BIOSC 632</b>                             | <b>ANIMAL HISTOLOGY</b><br>3 cr. (3 and 0)                                | <b>BIOSC 665</b>                | <b>PLANT MOLECULAR BIOLOGY</b><br>3 cr. (3 and 0)                                                                |
| <b>BIOSC 633</b>                             | <b>ANIMAL HISTOLOGY LABORATORY</b><br>2 cr. (1 and 2)                     | <b>BIOSC 670</b>                | <b>ANIMAL BEHAVIOR</b><br>3 cr. (3 and 0)                                                                        |
| <b>BIOSC 635</b>                             | <b>PRINCIPLES OF EVOLUTION</b><br>4 cr. (4 and 0)                         | <b>BIOSC 671</b>                | <b>ANIMAL BEHAVIOR LABORATORY</b><br>1 cr. (0 and 3)                                                             |
| <b>BIOSC 640</b>                             | <b>DEVELOPMENTAL ANIMAL BIOLOGY</b><br>3 cr. (3 and 0)                    | <b>BIOSC 675</b>                | <b>COMPARATIVE PHYSIOLOGY</b><br>3 cr. (3 and 0)                                                                 |
| <b>BIOSC 641</b>                             | <b>ECOLOGY</b><br>3 cr. (3 and 0)                                         | <b>BIOSC 676</b>                | <b>COMPARATIVE PHYSIOLOGY<br/>LABORATORY</b><br>2 cr. (1 and 2)                                                  |
| <b>BIOSC 642</b>                             | <b>BIOGEOGRAPHY</b><br>3 cr. (3 and 0)                                    | <b>BIOSC 680</b>                | <b>VERTEBRATE ENDOCRINOLOGY</b><br>3 cr. (3 and 0)                                                               |
|                                              |                                                                           | <b>BIOSC 801</b><br>(AN PH 801) | <b>ELECTRON MICROSCOPY OF<br/>BIOLOGICAL SPECIMENS</b><br>3 cr. (1 and 6) F, S<br>See AN PH 801 for description. |



- BIOSC 815 DEVELOPMENTAL GENETICS**  
3 cr. (3 and 0)  
Current research in developmental genetics. Topics include 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. **Prerequisites:** A semester of biochemistry and a semester of genetics.
- BIOSC 871 SELECTED TOPICS**  
1-4 cr. (1-4 and 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. **Prerequisite:** Permission of instructor.
- BIOSC 872 SELECTED TOPICS LABORATORY**  
1-4 cr. (0 and 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. **Prerequisite:** Permission of instructor.

## Biology

William M. Surver, Acting Chair, Biology Program

The Biology Program does not offer advanced degrees: see the Department of Biological Sciences for graduate programs in biology. The courses listed below are taught by faculty in the life sciences for elementary and secondary education majors.

- BIOL 710 SELECTED TOPICS FOR TEACHERS**  
1-6 cr. (0-6 and 0-18)  
Study of one or more topics organized according to institute needs; 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.

## Botany

John E. Faurey, Program Coordinator, Department of Biological Sciences

| Majors           | Degrees |
|------------------|---------|
| Botany           | M.S.    |
| Plant Physiology | Ph.D.   |

Candidates for graduate work in botany or plant physiology should have a strong undergraduate background in the biological and physical sciences. Undergraduate curricula which may provide this background are botany, biology or chemistry, or one of the agricultural plant sciences such as agronomy, forestry or horticulture.

All candidates for the Master of Science degree must complete 24 semester hours of course work and six hours of research, and must present and defend a thesis based on original research.

The department participates in an interdepartmental program awarding the Doctor of Philosophy degree with a major in plant

physiology. This program offers considerable opportunity for doctoral research in botany.

- BOT 613 PHYCOLOGY**  
4 cr. (3 and 3) S (even numbered years)
- BOT 807 SEMINAR**  
1 cr. (1 and 0) F, S  
Areas of botanical sciences not covered in other courses; student reviews literature, organizes and presents material. May be taken for credit only twice.
- BOT 821 INORGANIC PLANT METABOLISM**  
3 cr. (3 and 0) F (odd numbered years)  
Plant, soil, water and nutrient relations; permeability; uptake and translocation; transpiration; mineral nutrition. **Prerequisites:** BIOSC 401/601 and 402/602 or permission of instructor.
- BOT 822 ORGANIC PLANT METABOLISM**  
3 cr. (3 and 0) S (even numbered years)  
Respiration and photosynthesis; synthesis, translocation, storage, transformation and degradation of organic materials, fats, carbohydrates, proteins, pigments and nucleic acids. **Prerequisites:** BIOSC 601 and 602 and BIOCH 623, or permission of instructor.
- BOT 823 PLANT GROWTH AND DEVELOPMENT**  
3 cr. (3 and 0) F (even numbered years)  
Vegetative and reproductive growth and development from seed to maturity, flowering, fruiting and senescence; natural and synthetic growth regulators; morphogenesis. **Prerequisites:** BIOSC 401/601 and 402/602, organic chemistry or permission of instructor.
- BOT 824 MODE OF ACTION OF GROWTH SUBSTANCES**  
4 cr. (3 and 3) S (odd numbered years)  
Physiology and biochemistry of both natural and synthetic growth regulators, hormones, growth retardants, herbicides and other inhibitors; methodology and mechanism of action. **Prerequisites:** BIOSC 401/601 and 402/602 and general biochemistry, or BOT 822 or permission of instructor.
- BOT 831 ADVANCED PLANT TAXONOMY**  
4 cr. (3 and 3) S (odd numbered years)  
Principles of plant classification; relationships and characteristics of major groups of vascular plants; student collects and identifies spring flora of area. **Prerequisite:** BIOSC 406/606 or permission of instructor.
- BOT 846 PLANT ECOLOGY**  
4 cr. (3 and 3) F  
Detailed study of the effects of environmental factors upon plants and the influence of plants upon the environment; identification and analysis of interrelated biotic and physical factors that affect the structure, distribution and dynamics of individual plants, plant populations and ecosystems. **Prerequisite:** BIOSC 441/641 or permission of instructor.



|                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                   |                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>BOT 847</b>                                                                                                                                  | <b>PLANT-ANIMAL INTERACTIONS</b><br>3 cr. (3 and 0)<br>Examination of plant-animal interactions from an ecological and evolutionary perspective. Topics include herbivory, pollination and seed dispersal as well as effects of animals on plant populations and influence of plants on animal diversity and abundance. <b>Prerequisite:</b> BIOSC 441/641 or BIOSC 446/646 or permission of instructor.          | <b>ENT 603</b>                       | <b>FIELD CROP ENTOMOLOGY</b><br>3 cr. (2 and 3)                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>BOT 850</b>                                                                                                                                  | <b>PLANT TISSUE AND CELL CULTURE</b><br>3 cr. (2 and 3) F (odd numbered years)<br>Consideration of methods and principles of plant tissue and cell culture: cloning, embryogenesis, protoplast fusion, plant regeneration, potential of plant genetic engineering. <b>Prerequisite:</b> Introductory plant physiology or permission of instructor.                                                                | <b>ENT 604</b>                       | <b>URBAN ENTOMOLOGY</b><br>3 cr. (2 and 3)                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>BOT 851</b><br><b>(HORT 851)</b>                                                                                                             | <b>PLANT ANATOMY</b><br>3 cr. (2 and 3) F (odd numbered years)<br>Study of the origin, development and comparative structures of tissues, systems and organs of higher plants. <b>Prerequisite:</b> BIOSC 452/652 or permission of instructor.                                                                                                                                                                    | <b>ENT 605</b>                       | <b>INSECT MORPHOLOGY</b><br>4 cr. (3 and 3)                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>BOT 861</b>                                                                                                                                  | <b>PLANT CELL BIOLOGY</b><br>3 cr. (3 and 0) F (odd numbered years)<br>Structure, development and activities of plant cells; ultrastructural organization uniquely associated with dynamics of cellular growth and development in plants. <b>Prerequisites:</b> BIOSC 401/601 and 402/602 or permission of instructor.                                                                                            | <b>ENT 606</b><br><b>(PL PA 606)</b> | <b>DISEASES AND INSECTS OF TURFGRASSES</b><br>3 cr. (2 and 2)                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>BOT 891</b>                                                                                                                                  | <b>MASTER'S THESIS RESEARCH</b><br>Credit to be arranged.                                                                                                                                                                                                                                                                                                                                                         | <b>ENT 610</b>                       | <b>INSECT TAXONOMY</b><br>3 cr. (1 and 6)                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>BOT 921</b><br><b>(HORT 921)</b>                                                                                                             | <b>PLANT PHYSIOLOGY COLLOQUIUM</b><br>1 cr. (1 and 0)<br>Topics from current plant physiology literature provide a forum for criticizing research, conceiving new research ideas, developing research outlines and proposals, and integrating knowledge from various subdisciplines of plant physiology. May be repeated for credit. <b>Prerequisites:</b> BIOSC 401/601 and 402/602 or permission of instructor. | <b>ENT 612</b>                       | <b>FIELD AND MUSEUM ENTOMOLOGY</b><br>3 cr. (0 and 9)                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>BOT 991</b>                                                                                                                                  | <b>DOCTORAL DISSERTATION RESEARCH</b><br>Credit to be arranged.                                                                                                                                                                                                                                                                                                                                                   | <b>ENT 620</b>                       | <b>TOXICOLOGY OF INSECTICIDES</b><br>3 cr. (2 and 3)                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Entomology</b><br>Thomas E. Skelton, Chair, Department of Entomology                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>ENT 630</b><br><b>(ENTOX 630)</b> | <b>TOXICOLOGY</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Major</b><br>Entomology                                                                                                                      | <b>Degrees</b><br>M.S., Ph.D.                                                                                                                                                                                                                                                                                                                                                                                     | <b>ENT 640</b>                       | <b>INSECT BEHAVIOR</b><br>3 cr. (2 and 3)                                                                                                                                                                                                                                                                                                                                                                                                              |
| Candidates for the M.S. degree are required to complete a thesis, a minimum of 24 credit hours of course work and six credit hours of research. |                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>ENT 655</b>                       | <b>MEDICAL AND VETERINARY ENTOMOLOGY</b><br>3 cr. (2 and 3)                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>ENT 601</b>                                                                                                                                  | <b>INSECT PESTS OF ORNAMENTAL PLANTS AND SHADE TREES</b><br>3 cr. (2 and 3)                                                                                                                                                                                                                                                                                                                                       | <b>ENT 662</b>                       | <b>SEMINAR</b><br>1 cr. (1 and 0)                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>ENT 602</b>                                                                                                                                  | <b>FRUIT, NUT AND VEGETABLE INSECTS</b><br>3 cr. (2 and 3)                                                                                                                                                                                                                                                                                                                                                        | <b>ENT 668</b>                       | <b>MANAGEMENT SKILLS FOR SCIENTISTS</b><br>2 cr. (2 and 0)                                                                                                                                                                                                                                                                                                                                                                                             |
|                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>ENT 669</b><br><b>(W F B 669)</b> | <b>AQUATIC INSECTS</b><br>3 cr. (1 and 6) S (odd numbered years)                                                                                                                                                                                                                                                                                                                                                                                       |
|                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>ENT 670</b>                       | <b>INSECT PHYSIOLOGY</b><br>3 cr. (2 and 3)                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>ENT 680</b>                       | <b>INSECT PATHOLOGY</b><br>3 cr. (2 and 3)                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>ENT 700</b>                       | <b>ENTOMOLOGY FOR TEACHERS</b><br>3 cr. (2 and 2) SS<br>General entomology course for secondary school science teachers, with emphasis on collecting and identifying the more common insects. Additional topics include insect morphology, physiology, metamorphosis and methods available for control of destructive species. Not open to entomology majors pursuing the M.S., M.Ag. or Ph.D. degrees. <b>Prerequisite:</b> Permission of instructor. |
|                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>ENT 808</b>                       | <b>TAXONOMY OF IMMATURE INSECTS</b><br>3 cr. (1 and 6) F (odd numbered years)<br>Identification of immature insects, emphasizing the Holometabola; identified collection required.                                                                                                                                                                                                                                                                     |
|                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>ENT 809</b>                       | <b>SEMINAR IN ENTOMOLOGY</b><br>1 cr. (1 and 0)<br>Current literature and research in entomology; class attendance is mandatory. May be repeated for credit. Graded on a pass/fail basis.                                                                                                                                                                                                                                                              |



- ENT 810**      **SELECTED TOPICS**  
1-4 cr. (1-4 and 0)  
Current areas of entomological research and pest management. Course may be repeated for credit. **Prerequisite:** Permission of instructor.
- ENT 812**      **ENTOMOLOGY HISTORY AND LITERATURE**  
1 cr. (1 and 0) F (even numbered years)  
Literature related to development of the science of entomology; reading in the available journals, indexing and abstracting journals required.
- ENT 840**      **INSECT ECOLOGY**  
3 cr. (2 and 3) S (even numbered years)  
Principles of insect ecology, population dynamics and natural regulating mechanisms of insect populations; effect of environment on distribution and abundance of insects.
- ENT 853**      **APPLIED SYSTEMATICS**  
3 cr. (2 and 3) S (even numbered years)  
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. **Prerequisite:** A taxonomic course in entomology or zoology or permission of instructor.
- ENT 860**      **INSECT PEST MANAGEMENT**  
3 cr. (3 and 0) S (odd numbered years)  
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.
- ENT 863**      **SPECIAL PROBLEMS IN ENTOMOLOGY**  
1-3 cr. (0 and 3-9)  
Entomological research not related to thesis. **Prerequisite:** Permission of instructor.
- ENT 891**      **MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- ENT 991**      **DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

### Environmental Toxicology

Ronald J. Kendall, Chair, Department of Environmental Toxicology

**Major**  
Environmental  
Toxicology

**Degrees**  
M.S., Ph.D.

Students with a baccalaureate degree in the basic and life sciences, agriculture or engineering may be admitted.

Each student's research program is designed to meet his or her professional goals. Candidates for the M.S. degree must complete 30 hours of graduate credit, including six hours of research, and write a thesis. Candidates for the Ph.D. degree must complete 18 hours of dissertation research and write a dissertation.

- ENTOX 600**      **ENVIRONMENT AND WILDLIFE TOXICOLOGY**  
3 cr. (3 and 0)

- ENTOX 621**      **CHEMICAL SOURCES AND FATE IN ENVIRONMENTAL SYSTEMS**  
3 cr. (3 and 0)
- ENTOX 630 (ENT 630)**      **TOXICOLOGY**  
3 cr. (3 and 0)
- ENTOX 801**      **ADVANCED WILDLIFE TOXICOLOGY**  
3 cr. (3 and 0)  
Interactions between chemical contaminants and wildlife species, focusing on mechanisms of differential toxicities between chemicals and among species; pesticide and chemical contaminant impacts are developed with emphasis on chemical, biochemical and physiological underpinnings and assessed in terms of organismal, species and trophic responses. **Prerequisites:** ENTOX 430/630 and 421/621; or permission of instructor.
- ENTOX 806**      **ADVANCED ENVIRONMENTAL TOXICOLOGY**  
3 cr. (3 and 0)  
Impacts of chemical contaminants upon ecosystems; description and prediction of ecological changes resulting from a variety of human activities which involve release of xenobiotic and other chemicals into the environment. **Prerequisites:** Organic chemistry, ENT/ENTOX 430/630 and analytical chemistry; or permission of instruction.
- ENTOX 822**      **ANALYTICAL TOXICOLOGY LABORATORY**  
3 cr. (1 and 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. **Prerequisites:** Organic and analytical chemistry or permission of instructor; instrumental analysis recommended.
- ENTOX 830**      **MECHANISTIC TOXICOLOGY**  
3 cr. (3 and 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; and biochemical and molecular biomarkers. **Prerequisite:** ENT/ENTOX 430/630.
- ENTOX 831**      **BIOMARKERS IN TOXICOLOGY**  
3 cr. (1 and 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. **Prerequisites:** Organic chemistry and biochemistry with laboratory; ENT/ENTOX 430/630 or 400/600; or permission of instructor.



- ENTOX 841 PROCEDURES AND TECHNIQUES IN ECOLOGICAL RISK ASSESSMENT**  
2 cr. (1 and 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; focus is on impacts to biota within, and resulting from, chemical waste disposal facilities and hazardous waste sites. **Prerequisites:** CH 223, 224 and 313; EX ST 840 or 805; and ENTOX 630; or permission of instructor.
- ENTOX 852 ECOLOGICAL MODELS**  
3 cr. (2 and 3) N  
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 function for population interactions. **Prerequisite:** A course in ecology and in computer programming or permission of instructor.
- ENTOX 854 AQUATIC TOXICOLOGY**  
3 cr. (3 and 0)  
Concepts and practices in aquatic toxicology, including physiological responses to toxic substances, bioconcentration, biomagnification, toxicity testing (algal, invertebrate and fish) and criterion development; acquaints students interested in the environmental sciences and environmental policy with basic concepts of toxicology as applied to aquatic environments. **Prerequisites:** One year of general biology, one year of general chemistry and introductory biochemistry.
- ENTOX 860 GRADUATE SEMINAR**  
1 cr. (1 and 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. Graded on a pass/fail basis.
- ENTOX 861 DEPARTMENTAL SEMINAR**  
1 cr. (1 and 0)  
Presentation of current research by Department of Environmental Toxicology faculty, staff, finishing graduate students and invited speakers; students improve skills in evaluation of research plans and oral presentations, and increase awareness of literature resources and employment opportunities within the field. May be repeated four times for credit.
- ENTOX 863 SELECTED TOPICS**  
1-4 cr. (0-4 and 0-6)  
A topic in environmental toxicology not covered in another course. Topics vary with current developments in the discipline. Course may be repeated if topic and content are different. **Prerequisite:** Permission of instructor.
- ENTOX 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.

- ENTOX 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

### Experimental Statistics

Hoke S. Hill, Jr., Acting Chair, Department of Experimental Statistics

Advanced degrees in experimental statistics are not awarded. A minor is offered at the master's and doctoral levels. Courses are offered for students majoring in other disciplines. Courses to be used to satisfy a minor should be approved by this department at the beginning of the student's program. At the master's level, minimum requirements are eight credit hours of 800-level courses with one hour of EX ST 811 acceptable. At the doctoral level, minimum requirements are 12 credit hours of 800-level courses with up to four hours of EX ST 811 acceptable.

- EX ST 611 STATISTICAL METHODS FOR PROCESS DEVELOPMENT AND CONTROL**  
3 cr. (3 and 0) S
- EX ST 662 STATISTICS APPLIED TO ECONOMICS**  
3 cr. (3 and 0) F
- EX ST 801 STATISTICAL METHODS**  
4 cr. (3 and 3) F, S  
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. **Prerequisite:** Permission of instructor.
- EX ST 803 REGRESSION AND LEAST SQUARES ANALYSIS**  
3 cr. (3 and 0) F  
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. **Prerequisite:** EX ST 801.
- EX ST 804 SAMPLING**  
3 cr. (3 and 0) F  
Principles of scientific sampling; finite population sampling; simple random, stratified, multi-stage 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. **Prerequisite:** EX ST 801.
- EX ST 805 DESIGN AND ANALYSIS OF EXPERIMENTS**  
3 cr. (3 and 0) F, S  
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. **Prerequisite:** EX ST 801.



**EX ST 811 SPECIAL PROBLEMS IN EXPERIMENTAL STATISTICS**  
1-3 cr. (0 and 2-6)  
Statistical aspects of an individualized research problem; emphasis on determining an appropriate experimental design, performing proper analyses and generating effective reports.

**EX ST 812 SPECIAL TOPICS IN EXPERIMENTAL STATISTICS**  
1-3 cr. (1-3 and 0) S  
Selected topics in applied statistics not covered in other courses.

### Food Science

Ronald D. Galyean, Chair, Department of Food Science

| Majors                     | Degrees     |
|----------------------------|-------------|
| Animal and Food Industries | M.S.        |
| Plant Physiology           | Ph.D.       |
| Food Technology            | Ph.D.       |
| Nutrition                  | M.S., Ph.D. |

A degree is not offered in this department. Degrees in the above areas with a concentration in food science are offered. Candidates for the M.S. and Ph.D. degrees must complete a research project and submit a thesis or dissertation. The M.S. degree requires a minimum of 24 credit hours of course work and six credit hours of research.

**FD SC 601 FOOD CHEMISTRY I**  
4 cr. (3 and 3) F (even numbered years)

**FD SC 602 FOOD CHEMISTRY II**  
4 cr. (3 and 3) S (odd numbered years)

**FD SC 603 FOOD PRESERVATION AND PROCESSING I**  
3 cr. (3 and 0) F (odd numbered years)

**FD SC 604 FOOD PRESERVATION AND PROCESSING II**  
3 cr. (3 and 0) S (even numbered years)

**FD SC 605 FOOD PRESERVATION AND PROCESSING LABORATORY I**  
1 cr. (0 and 3) F (odd numbered years)

**FD SC 606 FOOD PRESERVATION AND PROCESSING LABORATORY II**  
1 cr. (0 and 3) S (even numbered years)

**FD SC 622 QUALITY ASSURANCE AND SENSORY EVALUATION**  
2 cr. (2 and 0)

**FD SC 624 QUALITY ASSURANCE AND SENSORY EVALUATION LABORATORY**  
1 cr. (0 and 3)

**FD SC 664 FOOD PACKAGING SYSTEMS**  
3 cr. (3 and 0)

**FD SC 666 FOOD PACKAGING SYSTEMS LABORATORY**  
1 cr. (0 and 3)

**FD SC 810 CHEMICAL AND BIOCHEMICAL ASPECTS OF FOODS**  
4 cr. (4 and 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. **Prerequisites:** BIOCH 623 and FD SC 401/601 or permission of instructor.

**FD SC 811 PHYSICAL AND THERMOPHYSICAL PROPERTIES OF FOODS**  
3 cr. (3 and 0)  
Principles involved in relating physical and thermophysical properties to food quality, including standard methods and instruments to determine texture and the relationship of physical properties to sensory evaluation; emphasis on interrelationships of chemical structure and physical properties in food processing operations. **Prerequisite:** FD SC 810 or permission of instructor.

**FD SC 812 MICROBIOLOGICAL ASPECTS OF FOOD SYSTEMS**  
3 cr. (3 and 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. **Prerequisite:** MICRO 407/607 or equivalent or permission of instructor.

**FD SC 820 SPECIAL TOPICS IN FOOD SCIENCE**  
1-3 cr. (1-3 and 0)  
Special topics in food science not covered in other courses. Cumulative credits are not to exceed four.

**FD SC 821 SPECIAL PROBLEMS IN FOOD SCIENCE**  
1-3 cr. (0 and 3-9)  
Independent research investigation in food science areas not conducted in other courses. Cumulative maximum of three credits. **Prerequisite:** Permission of instructor.

**FD SC 851 FOOD SCIENCE SEMINAR**  
1 cr. (1 and 0)  
Current research and related developments in food science reviewed by faculty, students and invited lecturers.

**FD SC 852 FOOD SCIENCE SEMINAR**  
1 cr. (1 and 0)  
Continuation of FD SC 851.

**FD SC 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.

### Food Technology

Ronald L. Thomas, Program Chairman, Department of Food Science

| Major           | Degree |
|-----------------|--------|
| Food Technology | Ph.D.  |

The food technology doctoral program is an interdepartmental program. Applicants must have a strong background in food science and technology and related areas.

Required courses include FD TH 851 and FD TH 991. Additional courses may be selected from other areas as required by the student's graduate advisory committee.



- FD TH 851 FOOD TECHNOLOGY SEMINAR**  
1 cr. (1 and 0) F, S  
Current and ongoing research, as well as developments in food technology reviewed by faculty, students and invited lecturers. **Prerequisite:** Enrollment in the Food Technology Ph.D. program or permission of instructor.

- FD TH 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

## Forest Resources

B. Allen Dunn, Chair, Department of Forest Resources

| Major            | Degrees             |
|------------------|---------------------|
| Forest Resources | M.F.R., M.S., Ph.D. |

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 Master of Forest Resources, a nonthesis degree, requires a minimum of 36 semester hours of graduate course work with at least 18 of the required hours coming from courses numbered 700 or above.

A formal thesis is required for the Master of Science and the Doctor of Philosophy degrees. The Master of Science degree requires a minimum of 24 semester hours of course work and six hours of research. The Doctor of Philosophy degree requires a minimum of 16 semester hours of course work and 18 hours of research.

- |                |                                                                   |                                             |                                                                                                   |
|----------------|-------------------------------------------------------------------|---------------------------------------------|---------------------------------------------------------------------------------------------------|
| <b>FOR 600</b> | <b>PUBLIC RELATIONS IN NATURAL RESOURCES</b><br>3 cr. (3 and 0) S | <b>FOR 615</b>                              | <b>FOREST WILDLIFE MANAGEMENT</b><br>3 cr. (2 and 3) S                                            |
| <b>FOR 602</b> | <b>FOREST RESOURCE MEASUREMENTS II</b><br>3 cr. (2 and 3) S       | <b>FOR 616</b>                              | <b>FOREST POLICY AND ADMINISTRATION</b><br>2 cr. (2 and 0) F                                      |
| <b>FOR 604</b> | <b>FOREST RESOURCE ECONOMICS</b><br>3 cr. (3 and 0) F             | <b>FOR 617</b>                              | <b>FOREST RESOURCE MANAGEMENT AND REGULATION</b><br>3 cr. (3 and 0) F                             |
| <b>FOR 606</b> | <b>WOOD AND WOOD FIBER IDENTIFICATION</b><br>2 cr. (1 and 3) F    | <b>FOR 618</b>                              | <b>FOREST RESOURCE VALUATION</b><br>2 cr. (2 and 0) F                                             |
| <b>FOR 607</b> | <b>FOREST OPERATIONS</b><br>3 cr. (2 and 3) F                     | <b>FOR 620</b>                              | <b>FOREST PRODUCTS</b><br>3 cr. (2 and 3) S                                                       |
| <b>FOR 608</b> | <b>AERIAL PHOTOGRAPHS IN FORESTRY</b><br>3 cr. (2 and 3) S        | <b>FOR 621</b>                              | <b>BIOLOGY AND SILVICULTURE OF HARDWOOD FORESTS</b><br>2 cr. (1 and 2) F                          |
| <b>FOR 609</b> | <b>MULTIPLE-USE FORESTRY</b><br>2 cr. (2 and 0) S                 | <b>FOR 622</b>                              | <b>FOREST PRODUCTS INTERNATIONAL TRADE</b><br>3 cr. (3 and 0) F                                   |
| <b>FOR 610</b> | <b>SILVICULTURE I</b><br>4 cr. (3 and 3) S                        | <b>FOR 623</b>                              | <b>CURRENT ISSUES IN NATURAL RESOURCES</b><br>2 cr. (2 and 0) F, S                                |
| <b>FOR 611</b> | <b>HARVESTING FOREST PRODUCTS</b><br>3 cr. (2 and 3) S            | <b>FOR 629</b>                              | <b>WOOD DESIGN</b><br>3 cr. (2 and 3) F                                                           |
| <b>FOR 612</b> | <b>FOREST PROTECTION</b><br>2 cr. (2 and 0) S                     | <b>FOR 630</b>                              | <b>COMPOSITE WOOD MATERIALS</b><br>3 cr. (2 and 3) F                                              |
| <b>FOR 613</b> | <b>INTEGRATED FOREST PEST MANAGEMENT</b><br>3 cr. (3 and 0) F     | <b>FOR 631</b>                              | <b>RECREATION RESOURCE PLANNING IN FOREST MANAGEMENT</b><br>2 cr. (1 and 3) S                     |
| <b>FOR 614</b> | <b>FOREST MANAGEMENT PLANS</b><br>2 cr. (2 and 0) S               | <b>FOR 632</b>                              | <b>FOREST SITE CAPABILITY</b><br>2 cr. (2 and 0) S                                                |
|                |                                                                   | <b>FOR 634</b>                              | <b>FOREIGN WOODS AND THEIR PROPERTIES</b><br>2 cr. (1 and 3) S                                    |
|                |                                                                   | <b>FOR 635</b>                              | <b>PARK AND FOREST STRUCTURES</b><br>2 cr. (2 and 0) F                                            |
|                |                                                                   | <b>FOR 641</b>                              | <b>PROPERTIES OF WOOD PRODUCTS</b><br>3 cr. (3 and 0)                                             |
|                |                                                                   | <b>FOR 642</b>                              | <b>MANUFACTURE OF WOOD PRODUCTS I</b><br>3 cr. (3 and 0)                                          |
|                |                                                                   | <b>FOR 643</b>                              | <b>MANUFACTURE OF WOOD PRODUCTS II</b><br>3 cr. (3 and 0)                                         |
|                |                                                                   | <b>FOR 644</b>                              | <b>FOREST PRODUCTS MARKETING AND INTERNATIONAL TRADE</b><br>3 cr. (3 and 0)                       |
|                |                                                                   | <b>FOR 645</b>                              | <b>FOREST PRODUCTS AND THE ENVIRONMENT</b><br>3 cr. (3 and 0)                                     |
|                |                                                                   | <b>FOR 646</b>                              | <b>WOOD PRODUCTS APPLICATIONS AND SPECIFICATIONS</b><br>3 cr. (3 and 0)                           |
|                |                                                                   | <b>FOR 651</b><br>(AG E 651)<br>(E S E 651) | <b>NEWMAN SEMINAR AND LECTURE SERIES IN NATURAL RESOURCES ENGINEERING</b><br>1 cr. (0 and 2) S, F |



- FOR 662 SILVICULTURE II**  
3 cr. (2 and 3)
- FOR 707 SPECIAL PROBLEMS IN FORESTRY**  
1-3 cr. (1-3 and 0)  
Directed individual study of a special problem in an applied field of forestry; written report of study results required.
- FOR 801 DATA PROCESSING IN FORESTRY PROBLEMS**  
3 cr. (2 and 3) S  
Illustration, analysis and discussion of specific approaches used in forestry problems for handling, arranging and analyzing large volumes of field data and for presentation in concise, meaningful form. **Prerequisite:** Permission of instructor.
- FOR 802 ADVANCED MENSURATION**  
3 cr. (2 and 3) S (even numbered years)  
Continuation of FOR 602, emphasizing specialized sampling techniques and statistical methods often required only in forestry; compilation of timber volume tables; forest survey problems. **Prerequisites:** EX ST 301 and FOR 302/602 or permission of instructor.
- FOR 804 ADVANCED FOREST ECONOMICS**  
3 cr. (2 and 3) F (even numbered years)  
Examination, discussion and application of economic principles to forestry problems in use of land, labor and capital; use of theory in problems of resource allocation and efficiency in forest management. **Prerequisites:** FOR 304/604 and 418/618 or permission of instructor.
- FOR 805 FOREST LANDSCAPE ECOSYSTEMS**  
4 cr. (3 and 3) F (even numbered years)  
The three basic landscape components of soils, landform and vegetation and their interrelationships in forest ecosystems, emphasizing factors and processes of soils as interacting components with landform and vegetation. **Prerequisite:** Graduate standing or permission of instructor.
- FOR 806 ADVANCED SILVICULTURE—FOREST TREE GROWTH AND DEVELOPMENT**  
3 cr. (3 and 0) F (odd numbered years)  
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; examination of current research in growth and culture of forest trees and stands. **Prerequisites:** BIOSC 401/601 and 402/602 or permission of instructor.
- FOR 807 SPECIAL PROBLEMS IN FORESTRY**  
Credit to be arranged.  
Special problems in forestry research methods that do not directly pertain to the candidate's thesis.
- FOR 808 SEMINAR**  
1 cr. (1 and 0) F, S  
Discussions of research and current developments in forestry; students and staff participate. May be taken up to two semesters for credit. Graded on a pass/fail basis.
- FOR 809 PRODUCTS BIODETERIORATION**  
2 cr. (1 and 3) F (even numbered years)  
The role of microorganisms in reducing the strength, aesthetics and value of products in service, emphasizing the deterioration of wood.
- FOR 810 FOREST LANDSCAPE ECOSYSTEMS OF THE GREAT SMOKY MOUNTAINS**  
2 cr. (1 and 1)  
Observation and measurements of species composition, community structure, soil-site relationships, land use practices within the forest ecosystems of Great Smoky Mountains National Park; field data interpreted and illustrated using ordination and classification techniques common in ecological studies. **Prerequisite:** Permission of instructor.
- FOR 811 FOREST WETLAND ECOLOGY AND MANAGEMENT**  
2 cr. (2 and 0) S  
Assessment of ecological processes and how they influence forest wetland productivity, management and regulation. **Prerequisite:** Introductory ecology or permission of instructor.
- FOR 814 ADVANCED FOREST RESOURCE MANAGEMENT AND PLANNING**  
3 cr. (3 and 0) S (odd numbered years)  
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. **Prerequisite:** FOR 417/617 or permission of instructor.
- FOR 816 (PRTM 816) REMOTE SENSING AND GIS IN NATURAL RESOURCES**  
3 cr. (2 and 3) S (odd numbered years)  
Practical application of computer mapping, spatial analysis, and natural resource inventory using remote sensing and geographical information systems. **Prerequisite:** Permission of instructor.
- FOR 825 WOOD CHEMISTRY**  
3 cr. (2 and 3) F (even numbered years)  
Chemical composition of wood and related lignocellulosic substances and the chemistry of individual wood components; chemical reactions and applications of cellulose, hemicelluloses, lignin and extractives.
- FOR 826 APPLIED WOOD MECHANICS**  
3 cr. (3 and 0)  
Stress and strain of wood and wood products, orthotropic elasticity, stiffness and compliance matrices, application of elastic theory to structural systems, creep and relaxation of wood, theories and prediction of failure, analyses of layered wood composites, determination of mechanical properties and allowable stresses.



- FOR 827 WOOD PHYSICS**  
3 cr. (3 and 0)  
Thermodynamics and theories of moisture sorption in wood products; transport of moisture and heat. **Prerequisite:** Permission of instructor.
- FOR 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- FOR 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

## Genetics

Albert G. Abbott, Program Coordinator, Department of Biological Sciences

**Major**  
Genetics

**Degrees**  
M.S., Ph.D.

Applicants for the M.S. and Ph.D. degrees must have a bachelor's or master's degree in any area; chemistry through organic or biochemistry; a minimum of four credits of physics; mathematics through calculus; and biology including introductory genetics.

Certain core courses are required of all students. Other 800-level courses pertinent to the program of study and research are planned by the student and advisory committee to provide the student with a comprehensive knowledge of genetics.

The M.S. degree requires completion of 30 semester hours, including 24 hours of course work, six hours of research and a research thesis. The Ph.D. degree requires 18 hours of doctoral research credit, a research dissertation and a minimum of 24 hours of course work beyond the bachelor's degree. The course work is specified by the student's advisory committee with concurrence of the Genetics Program Committee.

- GEN 616 RECOMBINANT DNA**  
(BIOSC 616) 3 cr. (3 and 0)
- GEN 618 BIOTECHNOLOGY I: NUCLEIC ACIDS**  
(MICRO 618) **TECHNIQUES**  
(BIOSC 618) 4 cr. (2 and 4) N
- GEN 651 ADVANCED GENETICS**  
3 cr. (3 and 0) F
- GEN 701 MODERN DEVELOPMENTS IN GENETICS**  
3 cr. (3 and 0)  
Contemporary developments in genetics for secondary school teachers; genetic approaches to the problems of health and behavior; methods and equipment used to illustrate principles of genetics in theory and in the laboratory. **Prerequisite:** A genetics course or equivalent in biology courses.
- GEN 801 CYTOGENETICS**  
3 cr. (2 and 3) S (odd numbered years)  
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. **Prerequisite:** GEN 302 or equivalent.
- GEN 803 BIOMETRICAL GENETICS**  
3 cr. (3 and 0) S  
Statistical methodology in the study of population genetics; probability as applied to genetic

systems, gene and zygotic frequencies, derivation of genetic expectations, forces that change gene frequency, inbreeding, estimation and testing of genetic parameters, partitioning of variance, responses to selection and other statistical aspects of continuous variation. **Prerequisites:** GEN 451/651 and EX ST 801 or equivalent.

- GEN 806 SPECIAL PROBLEMS IN GENETICS**  
1-3 cr. (0 and 3-9)  
Research not related to a thesis.
- GEN 812 PHYSIOLOGICAL GENETICS**  
3 cr. (3 and 0)  
Advanced topics in the molecular aspects of physiological genetics. Topics include genes and metabolism, genes and signal transduction, oncogenes and growth, chromosomal aberrations, immunogenetics and others. **Prerequisites:** A semester of biochemistry and introductory genetics.
- GEN 825 GENETICS SEMINAR**  
1 cr. (1 and 0)  
Special topics and original research in genetics reviewed by students, faculty and invited lecturers. May be repeated for credit. **Prerequisite:** One semester of genetics.
- GEN 890 SPECIAL TOPICS IN GENETICS**  
1-3 cr. (1-3 and 0)  
Group discussion of recent developments in genetic research. May be repeated for a maximum of six credit hours. **Prerequisites:** GEN 302 and permission of instructor.
- GEN 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- GEN 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

## Horticulture

John W. Kelly, Chair, Department of Horticulture

**Majors**

Horticulture  
Plant Physiology

**Degrees**

M.S.  
Ph.D.

Master's degree candidates are required to conduct original research leading to a thesis. The M.S. degree requires a minimum of 24 credit hours of course work and six credit hours of research.

The department participates in interdepartmental programs awarding the Doctor of Philosophy degree. The Ph.D. program requires the performance of original research leading to a dissertation.

Each student's degree program is tailored to his or her professional goals with the guidance of an advisor and graduate committee. Graduate students in both the M.S. and Ph.D. degree programs are required to enroll in two semesters of seminar, HORT 809 (fall semester) and 810 (spring semester).

- HORT 606 NURSERY TECHNOLOGY**  
3 cr. (2 and 3) S
- HORT 612 TURF MANAGEMENT**  
3 cr. (2 and 3) F
- HORT 615 FOLIAGE PLANTS FOR INTERIOR UTILIZATION**  
3 cr. (2 and 3) F (odd numbered years)



- HORT 633 (AGRON 633) INTEGRATED WEED MANAGEMENT FOR AGRONOMIC AND HORTICULTURAL CROPS**  
3 cr. (2 and 2) S
- HORT 652 TREE FRUIT CULTURE AND PHYSIOLOGY**  
3 cr. (2 and 3) F (even numbered years)
- HORT 655 SMALL FRUIT CROPS**  
3 cr. (2 and 3) F (even numbered years)
- HORT 656 VEGETABLE CROPS**  
4 cr. (3 and 3) F
- HORT 661 PROBLEMS IN LANDSCAPE DESIGN**  
4 cr. (3 and 3) S
- HORT 664 POSTHARVEST HORTICULTURE**  
3 cr. (2 and 2) F
- HORT 670 HORTICULTURE AND HUMAN WELL-BEING**  
3 cr. (2 and 3) S
- HORT 671 ADVANCED INTERNSHIP**  
1-6 cr. (0 and 2-12)
- HORT 672 GARDEN EXPERIENCES IN YOUTH DEVELOPMENT**  
2 cr. (1 and 3)
- HORT 701 HORTICULTURE: PLANT AND ENVIRONMENTAL SCIENCE**  
3 cr. (2 and 3) SS  
Scope of South Carolina horticulture and how it affects the quality of life economically and aesthetically; exploration of environmental responsibilities; demonstration of methods of teaching plant principles; includes a three-day statewide field trip to horticultural industries. Not to be taken for credit by graduate students in horticulture.
- HORT 800 TOPICS IN HORTICULTURAL SCIENCE**  
1 cr. (1 and 0)  
Timely topics in horticultural science. May be repeated for a total of four credits, as topics and instructors vary. **Prerequisite:** Permission of instructor.
- HORT 802 RESEARCH SYSTEMS IN HORTICULTURE**  
3 cr. (2 and 3) F (even numbered years)  
Current trends, developments and techniques in horticultural research. **Prerequisites:** CH 223 and 227, or CH 201 and PHYS 207, or BIOCH 210.
- HORT 804 SCIENTIFIC ADVANCES IN ORNAMENTAL HORTICULTURE**  
3 cr. (3 and 0) S (odd numbered years)  
Research and current developments in ornamental horticulture covered in scientific periodicals.
- HORT 806 POSTHARVEST PHYSIOLOGY AND HANDLING OF HORTICULTURAL CROPS**  
3 cr. (3 and 0) S (even numbered years)  
Principles, developments and research findings dealing with physiological and biochemical changes and processes occurring in horticultural plant organs after harvest; biological aspects of methods and practices relating to harvesting, handling, transportation and storage of horticultural commodities for fresh market. **Prerequisites:** BIOSC 401/601 and 402/602 or equivalent.
- HORT 809 SEMINAR I**  
1 cr. (1 and 0) F  
Current topics in horticulture prepared and presented by the student.
- HORT 810 SEMINAR II**  
1 cr. (1 and 0) S  
Continuation of HORT 809.
- HORT 812 SPECIAL PROBLEMS IN HORTICULTURE**  
1-4 cr. (1-4 and 0)  
Research not related to a thesis. Course may be repeated for credit, but total credit may not exceed four hours. **Prerequisite:** Permission of instructor.
- HORT 813 PHOTOMORPHOGENESIS**  
3 cr. (2 and 2)  
Regulatory role of light quality in plant development (photomorphogenesis) and its consequences in and applications for crop production. **Prerequisites:** BIOSC 401/601 and 402/602 or permission of instructor; BOT 823 preferred.
- HORT 814 ENVIRONMENTAL PLANT STRESS PHYSIOLOGY**  
3 cr. (2 and 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. **Prerequisites:** BIOSC 401/601 and 402/602 or permission of instructor.
- HORT 851 (BOT 851) PLANT ANATOMY**  
3 cr. (2 and 3) F (odd numbered years)  
See BOT 851 for description.
- HORT 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- HORT 921 (BOT 921) PLANT PHYSIOLOGY COLLOQUIUM**  
1 cr. (1 and 0)  
See BOT 921 for description.
- HORT 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

### Microbiology

Lyndon L. Larcom, Acting Chair, Department of Microbiology

**Major**  
Microbiology

**Degrees**  
M.S., Ph.D.

Graduate work in microbiology requires sound undergraduate training in the biological and physical sciences. This training may be received in an undergraduate program 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 complete a curriculum which assures a sound knowledge of the basic areas of microbiology. The program is selected by the student with the guidance and approval of an advisory committee. Candidates for the M.S. degree must complete 30 hours of graduate credit including six hours of research, and present and defend a thesis based on original research.

Candidates for the Ph.D. degree must complete 18 hours of dissertation research, and present and defend a dissertation based on original research.

|                                                            |                                                                                                                                                                                                                                                                                     |
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| <b>MICRO 600</b>                                           | <b>PUBLIC HEALTH MICROBIOLOGY</b><br>3 cr. (3 and 0) S                                                                                                                                                                                                                              |
| <b>MICRO 601</b>                                           | <b>ADVANCED BACTERIOLOGY</b><br>4 cr. (2 and 6) F                                                                                                                                                                                                                                   |
| <b>MICRO 603</b>                                           | <b>MARINE MICROBIOLOGY</b><br>3 cr. (2 and 3) N                                                                                                                                                                                                                                     |
| <b>MICRO 605</b>                                           | <b>GENERAL MICROBIOLOGY</b><br>4 cr. (3 and 3)                                                                                                                                                                                                                                      |
| <b>MICRO 607</b>                                           | <b>FOOD AND DAIRY MICROBIOLOGY</b><br>4 cr. (3 and 3) S                                                                                                                                                                                                                             |
| <b>MICRO 610</b>                                           | <b>SOIL MICROBIOLOGY</b><br>3 cr. (2 and 3) S (even numbered years)                                                                                                                                                                                                                 |
| <b>MICRO 611</b>                                           | <b>PATHOGENIC BACTERIOLOGY</b><br>4 cr. (3 and 3) S                                                                                                                                                                                                                                 |
| <b>MICRO 612</b>                                           | <b>BACTERIAL PHYSIOLOGY</b><br>4 cr. (3 and 3) S                                                                                                                                                                                                                                    |
| <b>MICRO 613</b>                                           | <b>INDUSTRIAL MICROBIOLOGY</b><br>3 cr. (2 and 3) F                                                                                                                                                                                                                                 |
| <b>MICRO 614</b>                                           | <b>BASIC IMMUNOLOGY</b><br>3 cr. (2 and 3) F                                                                                                                                                                                                                                        |
| <b>MICRO 615</b>                                           | <b>MICROBIAL GENETICS</b><br>4 cr. (3 and 3) S                                                                                                                                                                                                                                      |
| <b>MICRO 616</b>                                           | <b>INTRODUCTORY VIROLOGY</b><br>3 cr. (3 and 0) F                                                                                                                                                                                                                                   |
| <b>MICRO 617</b>                                           | <b>MOLECULAR MECHANISMS OF CARCINOGENESIS AND AGING</b><br>3 cr. (3 and 0) S                                                                                                                                                                                                        |
| <b>MICRO 618</b><br><b>(BIOSC 618)</b><br><b>(GEN 618)</b> | <b>BIOTECHNOLOGY I: NUCLEIC ACIDS TECHNIQUES</b><br>4 cr. (2 and 4) N                                                                                                                                                                                                               |
| <b>MICRO 802</b>                                           | <b>BACTERIOLOGICAL TECHNIC</b><br>4 cr. (2 and 6) F<br>Analytical and experimental procedures used in bacteriology including techniques for studying bacterial cytology, physiology and metabolism; designed to give students experience in more advanced methods of investigation. |
| <b>MICRO 803</b>                                           | <b>SPECIAL PROBLEMS IN MICROBIOLOGY</b><br>Credit to be arranged. F, S, SS<br>Research not related to a thesis.                                                                                                                                                                     |
| <b>MICRO 804</b>                                           | <b>CURRENT TOPICS IN MICROBIOLOGY</b><br>1 cr. (1 and 0) F, S, SS<br>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.

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| <b>MICRO 805</b> | <b>TECHNIQUES OF CLINICAL MICROBIOLOGY AND IMMUNOBIOLOGY</b><br>3 cr. (2 and 3)<br>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. <b>Prerequisite:</b> MICRO 614, MICRO 615, BIOCH 623 or equivalent, or permission of instructor.                                                                                 |
| <b>MICRO 806</b> | <b>PATHOGENESIS AND INFECTIOUS DISEASE</b><br>3 cr. (3 and 0) SS<br>Medically important host-parasite relationships at the cellular and subcellular levels with emphasis on bacterial and viral infections in man. <b>Prerequisite:</b> MICRO 611 or permission of instructor.                                                                                                                                                                                                                                                                                                         |
| <b>MICRO 807</b> | <b>SEMINAR</b><br>1 cr. (1 and 0) F, S<br>Topics not covered in other courses; students review literature, organize and present material. May be taken twice for credit.                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>MICRO 808</b> | <b>BIOTECHNOLOGY AND MEDICINE</b><br>3 cr. (3 and 0)<br>Medical problems currently receiving attention due to the application of biotechnology to diagnosis or treatment; basic information essential to understanding the molecular biology of the disease and its diagnosis or treatment. <b>Prerequisite:</b> Permission of instructor.                                                                                                                                                                                                                                             |
| <b>MICRO 811</b> | <b>BACTERIAL CYTOLOGY AND PHYSIOLOGY</b><br>4 cr. (4 and 0) S (odd numbered years)<br>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. <b>Prerequisite:</b> MICRO 305/605; BIOCH 423/623; MTHSC 206; or permission of instructor.                                             |
| <b>MICRO 812</b> | <b>BACTERIAL METABOLISM</b><br>3 cr. (3 and 0) S (even numbered years)<br>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. <b>Prerequisite:</b> MICRO 305/605; BIOCH 423/623; MTHSC 206; or permission of instructor. |



- MICRO 815 ADVANCED MICROBIAL GENETICS**  
3 cr. (3 and 0) F  
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. **Prerequisite:** MICRO 415/615.
- MICRO 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- MICRO 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

## Nutrition

Denzil V. Maurice, Program Coordinator, Department of Poultry Science

Major  
Nutrition

Degrees  
M.S., Ph.D.

The M.S. and Ph.D. degree programs in nutrition are interdepartmental. Applicants should have a background in basic biological sciences appropriate for advanced study in the proposed area of specialization.

A student's program of study will include a core of basic courses. Additional course work may be taken in areas of special interest as approved by the advisory committee. A thesis or nonthesis option is available. The program of study for the nonthesis option must include a minimum of 30 graduate credits with at least eight credits in 800-level nutrition courses. These eight credits may not include topical problems in nutrition or credits for seminars.

The M.S. degree requires a minimum of 24 credit hours of course work and six credit hours of research.

- NUTR 601 FUNDAMENTALS OF NUTRITION**  
3 cr. (3 and 0) F
- NUTR 625 NUTRITION AND DIETETICS**  
3 cr. (3 and 0) F
- NUTR 651 HUMAN NUTRITION**  
3 cr. (3 and 0) F, S
- NUTR 655 NUTRITION AND METABOLISM**  
3 cr. (3 and 0) S
- NUTR 706 NUTRITION FOR TEACHERS**  
3 cr. (3 and 0) SS  
Principles of nutrition applied to nutrition education. **Prerequisite:** Permission of instructor.
- NUTR 801 TOPICAL PROBLEMS IN NUTRITION**  
1-3 cr. (1-3 and 0)  
Topics not covered in other courses or by thesis research. Credit varies with problems selected.
- NUTR 802 SPECIAL TOPICS IN NUTRITION**  
1-3 cr. (1-3 and 0) N  
Topics of special interest or contemporary subjects not examined in other courses.
- NUTR 808 MONOGASTRIC NUTRITION**  
3 cr. (3 and 0) F  
Basic concepts and current research related to nutrient requirement and metabolism of poultry,

swine and other monogastric species. **Prerequisite:** NUTR 401/601, 451/651 or P S 451/651.

- NUTR 809 RUMINANT NUTRITION**  
3 cr. (3 and 0) F  
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. **Prerequisite:** NUTR 401/601 or permission of instructor.
- NUTR 811 CARBOHYDRATE NUTRITION**  
2 cr. (2 and 0)  
The dietary sources, chemistry, absorption/excretion and functions of carbohydrates; the aberrations of metabolism and possible role in the etiology of degenerative diseases. **Prerequisites:** BIOCH 623 or equivalent; NUTR 601 or 651 or equivalent; or permission of instructor.
- NUTR 815 LIPID NUTRITION**  
2 cr. (2 and 0)  
Nutrition of lipids in humans and domestic animals emphasizing their source, digestion and absorption, metabolism, function, dietary needs and interrelationships. **Prerequisites:** BIOCH 623 or equivalent; NUTR 601 or 651 or equivalent; or permission of instructor.
- NUTR 816 AMINO ACIDS AND PROTEIN NUTRITION**  
2 cr. (2 and 0) F (odd numbered years)  
Nutrition of amino acids, nonprotein nitrogen and proteins related to humans and domestic animals; essentiality, interrelationships and metabolism of amino acids.
- NUTR 817 MINERAL NUTRITION**  
2 cr. (2 and 0)  
The occurrence, chemistry, absorption/excretion, and general and specific physiological functions of minerals. **Prerequisites:** BIOCH 623 or equivalent; NUTR 601 or 651 or equivalent; or permission of instructor.
- NUTR 819 VITAMIN NUTRITION**  
2 cr. (2 and 0)  
Overview of the chemistry, metabolism, physiology, digestion, absorption and excretion of the vitamins as applied to the nutrition of humans and domestic animals. **Prerequisites:** BIOCH 623 or equivalent; NUTR 601 or 651 or equivalent; or permission of instructor.
- NUTR 820 NUTRITIONAL BIOENERGETICS**  
2 cr. (2 and 0)  
Quantitative approach to the losses of dietary energy during digestion and metabolism, and the factors governing the energetic efficiency of different biological functions in animals and man; regulation of energy balance, body temperature regulation and techniques of calorimetry. **Prerequisites:** BIOCH 623 or equivalent; NUTR 601 or 651 or equivalent; or permission of instructor.



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| <b>NUTR 851</b> | <b>NUTRITION SEMINAR I</b><br>1 cr. (1 and 0) F<br>Current research and developments in nutrition. Topics, selected by the instructor and students, will come from student research and nutrition literature. |
| <b>NUTR 852</b> | <b>NUTRITION SEMINAR II</b><br>1 cr. (1 and 0) S<br>Continuation of NUTR 851.                                                                                                                                 |
| <b>NUTR 891</b> | <b>MASTER'S THESIS RESEARCH</b><br>Credit to be arranged.                                                                                                                                                     |
| <b>NUTR 991</b> | <b>DOCTORAL DISSERTATION RESEARCH</b><br>Credit to be arranged.                                                                                                                                               |

*The following courses offered by the various departments represent possible electives for the student in nutrition. Descriptions for all 800-level courses are under the respective departmental headings.*

|                  |                                                                    |
|------------------|--------------------------------------------------------------------|
| <b>BIOCH 606</b> | <b>PHYSIOLOGICAL CHEMISTRY</b><br>3 cr. (3 and 0)                  |
| <b>BIOCH 815</b> | <b>LIPIDS AND BIOMEMBRANES</b><br>3 cr. (3 and 0)                  |
| <b>BIOCH 817</b> | <b>CHEMISTRY AND METABOLISM OF HORMONES</b><br>3 cr. (3 and 0)     |
| <b>BIOCH 822</b> | <b>ENZYMES</b><br>3 cr. (3 and 0)                                  |
| <b>P S 651</b>   | <b>POULTRY NUTRITION</b><br>2 cr. (2 and 0) F (odd numbered years) |

### **Parks, Recreation and Tourism Management**

Lawrence R. Allen, Chair, Department of Parks, Recreation and Tourism Management

| <b>Major</b>                             | <b>Degrees</b>          |
|------------------------------------------|-------------------------|
| Parks, Recreation and Tourism Management | M.P.R.T.M., M.S., Ph.D. |

Applicants from nonrecreation disciplines are required to develop background knowledge of recreation through undergraduate course work. All applicants must submit scores from the Graduate Record Examinations.

Applicants for the M.P.R.T.M. degree who document at least three years of relevant professional experience beyond a bachelor's degree in recreation and a 3.0 undergraduate GPR are not required to submit GRE scores for admission. Each candidate completes an independent project to meet degree requirements. A minimum of 36 hours of course work is required.

The Master of Science is a research degree with a research thesis requirement. Candidates must complete a minimum of 30 hours of course work 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. Course work is determined by each student's doctoral committee.

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| <b>PRTM 600</b> | <b>SUPERVISION OF RECREATION PERSONNEL PATTERNS AND PROCESSES</b><br>3 cr. (3 and 0) |
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| <b>PRTM 601</b>          | <b>WORLD GEOGRAPHY OF RECREATION AND PARKS</b><br>3 cr. (3 and 0)                                             |
| <b>PRTM 611</b>          | <b>THERAPEUTIC RECREATION FOR SELECTED POPULATIONS</b><br>3 cr. (2 and 3)                                     |
| <b>PRTM 612</b>          | <b>THERAPEUTIC RECREATION AND MENTAL HEALTH</b><br>3 cr. (3 and 0)                                            |
| <b>PRTM 613</b>          | <b>THERAPEUTIC RECREATION FOR PHYSICALLY DISABLED</b><br>3 cr. (2 and 3)                                      |
| <b>PRTM 614 (ED 614)</b> | <b>RECREATION AND LEISURE FOR SPECIAL POPULATIONS</b><br>3 cr. (3 and 0)                                      |
| <b>PRTM 615 (ED 615)</b> | <b>DESIGNING COMPREHENSIVE SERVICES FOR ELEMENTARY CHILDREN AT RISK FOR SCHOOL FAILURE</b><br>3 cr. (2 and 3) |
| <b>PRTM 621</b>          | <b>RECREATION FINANCIAL RESOURCE MANAGEMENT</b><br>3 cr. (3 and 0)                                            |
| <b>PRTM 631</b>          | <b>METHODS OF ENVIRONMENTAL INTERPRETATION</b><br>3 cr. (2 and 3)                                             |
| <b>PRTM 641</b>          | <b>COMMERCIAL RECREATION</b><br>3 cr. (3 and 0)                                                               |
| <b>PRTM 643</b>          | <b>RESORTS IN NATIONAL AND INTERNATIONAL TOURISM</b><br>3 cr. (3 and 0)                                       |
| <b>PRTM 644</b>          | <b>TOUR PLANNING AND OPERATIONS</b><br>3 cr. (3 and 0)                                                        |
| <b>PRTM 645</b>          | <b>CONFERENCE/CONVENTION PLANNING AND MANAGEMENT</b><br>3 cr. (3 and 0)                                       |
| <b>PRTM 646</b>          | <b>COMMUNITY TOURISM DEVELOPMENT</b><br>3 cr. (3 and 0)                                                       |
| <b>PRTM 647</b>          | <b>PERSPECTIVES ON INTERNATIONAL TRAVEL</b><br>3 cr. (3 and 0)                                                |
| <b>PRTM 648</b>          | <b>MICRO-ORGANIZATION OF THE TOURISM INDUSTRY</b><br>3 cr. (3 and 0)                                          |
| <b>PRTM 652</b>          | <b>CAMPUS RECREATION</b><br>3 cr. (3 and 0)                                                                   |
| <b>PRTM 672</b>          | <b>HISTORIC SITE INTERPRETATION</b><br>3 cr. (3 and 0)                                                        |
| <b>PRTM 673</b>          | <b>INTRODUCTION TO MUSEOLOGY</b><br>3 cr. (2 and 3)                                                           |



- PRTM 701 FOUNDATIONS OF PARKS, RECREATION AND TOURISM MANAGEMENT**  
2 cr. (2 and 0)  
Basic concepts and principles in the parks, recreation and tourism management field. Does not count toward degree requirements for PRTM students. **Prerequisite:** Graduate standing.
- PRTM 705 INTERNSHIP**  
1-3 cr. (0 and 9+)  
Field placement in an approved agency under qualified supervision. Graded on a pass/fail basis. **Prerequisite:** PRTM student or permission of instructor.
- PRTM 706 COMPUTER-ASSISTED ADMINISTRATION IN LEISURE SERVICES**  
3 cr. (2 and 3)  
Decision-making and administrative techniques featuring the use of the microcomputer and related software to resolve administrative problems in the field of leisure services.
- PRTM 707 PRINCIPLES OF ENVIRONMENTAL INTERPRETATION**  
3 cr. (3 and 0)  
Methods of providing learning experiences in the out-of-doors, focusing on meaning, scope and values of interpretation.
- PRTM 708 INDEPENDENT STUDY**  
1-3 cr. (1-3 and 0)  
Topics in recreation, leisure and tourism; students study an area not covered in other courses; a written report of findings is required. May be repeated for a maximum of three credits. **Prerequisite:** Permission of the supervising faculty before registration.
- PRTM 709 SPECIAL PROBLEMS**  
1-3 cr. (1-3 and 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 required. May be repeated with a maximum of three credit hours applied toward graduation requirements. Graded on a pass/fail basis.
- PRTM 710 CURRENT ISSUES IN RECREATION**  
1 cr. (1 and 0)  
Seminar in current topics, emphasizing student preparation, organization and communication of material and ideas not covered in formal courses. May be repeated for a maximum of three semester hours of credit.
- PRTM 801 PHILOSOPHICAL FOUNDATIONS OF RECREATION AND PARK ADMINISTRATION**  
3 cr. (3 and 0)  
Current theories and philosophies in recreation as they are influenced by and have influence on leisure and the changing environment in America; student develops his or her own professional philosophy of recreation and leisure.
- PRTM 802 GROUP PROCESSES IN LEISURE SERVICES**  
3 cr. (3 and 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 cr. (3 and 0)  
Case problems relating to administration of a park, recreation or tourism agency.
- PRTM 804 COMPREHENSIVE RECREATION PLANNING**  
3 cr. (3 and 0)  
Comprehensive recreation planning theories and practices at federal, state and local levels; selected case study projects are undertaken in cooperation with other university departments and government agencies.
- PRTM 805 RECREATIONAL ASPECTS OF WATER RESOURCES**  
3 cr. (3 and 0)  
Relationship of recreation to water; history and legislative background; governmental involvement; current research related to planning, pollution and demand; future policy decisions.
- PRTM 806 URBAN RECREATION ANALYSIS**  
3 cr. (3 and 0)  
Interrelationship of social, political and economic factors in providing public or private recreation services in urban areas.
- PRTM 807 RECREATION BEHAVIOR IN NATURAL ENVIRONMENTS**  
3 cr. (3 and 0)  
The social, psychological and environmental influences on human behavior; identification of theoretical perspectives to explain behavior and to resolve problems in recreation resource management. **Prerequisite:** Graduate standing.
- PRTM 808 BEHAVIORAL ASPECTS OF PARKS, RECREATION AND TOURISM MANAGEMENT**  
3 cr. (3 and 0)  
Behavioral aspects of recreation, focusing on the social and psychological dimensions of the recreation experience in a variety of environments and activities. **Prerequisite:** Graduate standing.
- PRTM 811 RESEARCH METHODS IN PARKS, RECREATION AND TOURISM MANAGEMENT**  
3 cr. (3 and 0)  
Principles, methods and strategies for planning, designing, evaluating and applying studies of recreation. **Prerequisite:** A graduate-level statistics course or permission of instructor.



- PRTM 812 LEISURE SERVICES FOR THE ELDERLY**  
3 cr. (3 and 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 815 THERAPEUTIC RECREATION AND ACTIVITY THERAPY ADMINISTRATION**  
3 cr. (3 and 0)  
Service delivery structures; interdisciplinary relationships; consultation methods; in-service training; funding sources; service evaluation in therapeutic recreation and activity therapy programs.
- PRTM 816 REMOTE SENSING AND GIS IN NATURAL RESOURCES**  
(FOR 816)  
3 cr. (2 and 3) S (odd numbered years)  
See FOR 816 for description.
- PRTM 820 RECREATION RESOURCE POLICY ISSUES AND PROCESSES**  
3 cr. (3 and 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 cr. (3 and 0)  
Tourism planning procedures and techniques. Topics include the planning process and associated concerns such as market, facility, infrastructure, environment, culture and economics. **Prerequisite:** Graduate standing.
- PRTM 841 SEMINAR IN EXPOSITION MANAGEMENT**  
3 cr. (3 and 0)  
Students gain an understanding of the theory, concepts and practices necessary to assume positions with world fairs, agricultural fairs and arenas, trade shows, national and world trade centers, or consumer and industrial exhibitions.
- PRTM 843 TOURISM ANALYSIS**  
3 cr. (3 and 0)  
Selected theories, methods, techniques, practices and principles which govern tourism behavior. **Prerequisite:** Graduate standing or one graduate level statistics course or permission of instructor.
- PRTM 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- PRTM 900 SELECTED TOPICS**  
1-3 cr. (1-3 and 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 cr. (1-3 and 0)  
Advanced study of topics not covered in other PRTM courses and not directly related to a thesis or dissertation topic; a formal paper is required. May be taken for a maximum of

three credits per semester. May be repeated for a maximum of six credits. **Prerequisite:** Permission of instructor.

- PRTM 910 RESEARCH SEMINAR**  
1 cr. (1 and 0)  
Current research developments in PRTM and presentation of research projects. May be taken for credit for two semesters. Graded on a pass/fail basis.

- PRTM 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged

### Plant Pathology

Ottie J. Dickerson, Chair, Department of Plant Pathology and Physiology

| Major           | Degrees     |
|-----------------|-------------|
| Plant Pathology | M.S., Ph.D. |

Undergraduate programs in a crop science or biology generally provide a good background for graduate work in plant pathology.

Candidates for the M.S. degree are required to complete research presented in a thesis form. A minimum of 24 semester hours of course work is required. Research presented as a dissertation is required of Ph.D. candidates. No specific number of credit hours of course work is required for the Ph.D. About 24 credit hours beyond the M.S. are suggested as a minimum.

- PL PA 601 PLANT PATHOLOGY**  
3 cr. (2 and 2)
- PL PA 602 DISEASES OF ORNAMENTAL PLANTS**  
3 cr. (2 and 2) S
- PL PA 606 DISEASES AND INSECTS OF TURFGRASSES**  
(ENT 606)  
3 cr. (2 and 2)
- PL PA 611 PLANT DISEASE DIAGNOSIS**  
2 cr. (1 and 2) SS (odd numbered years)
- PL PA 651 BACTERIAL PLANT PATHOGENS**  
3 cr. (2 and 3) F (odd numbered years)
- PL PA 656 PLANT VIROLOGY**  
3 cr. (2 and 3) S (even numbered years)
- PL PA 658 PLANT PARASITIC NEMATODES**  
3 cr. (2 and 3) F (even numbered years)
- PL PA 800 ADVANCED PLANT PATHOLOGY**  
3 cr. (3 and 0) F (odd numbered years)  
Economic and social significance and history of plant pathology, host-parasite interactions (host defense mechanisms, mycotoxins, pathotoxins, mycoplasmas), ecology (mycorrhizae, pollution, soilborne plant pathogens), and disease loss and appraisal; selected pathogens used to illustrate concepts and principles; outside assignments introduce topics not covered in class. **Prerequisite:** PL PA 401.
- PL PA 801 EPIDEMIOLOGY AND CONTROL OF PLANT DISEASES**  
3 cr. (3 and 0) S (even numbered years)  
Epidemiology and control of plant diseases, including practical and theoretical coverage of chemical, physical and biological means of plant disease control. **Prerequisites:** PL PA 401 and organic chemistry.



- PL PA 802**      **SELECTED TOPICS**  
1-3 cr. (1-3 and 0-6)  
Current advances in phytopathology and physiology, diseases of specific crops, and specialized laboratory protocol. May be repeated for credit. **Prerequisite:** Permission of instructor.
- PL PA 803**      **FUNGAL PLANT PATHOGENS**  
3 cr. (1 and 6) S (odd numbered years)  
Plant pathogenic fungi, including recognition of fungus disease symptoms, isolation of fungi that cause diseases, cultural features of fungi, morphological characteristics, physiological reactions to environment, disease cycles, and management of pathogens and diseases. **Prerequisites:** BIOL 104 or equivalent, PL PA 401 and BIOSC 425/625.
- PL PA 804**      **PHYSIOLOGICAL PLANT PATHOLOGY**  
3 cr. (3 and 0) F (even numbered years)  
Interaction of pathogen and host in development of plant diseases; factors influencing infection; development of pathogen within host. **Prerequisites:** BIOSC 401/601 and 402/602, PL PA 401 and organic chemistry.
- PL PA 805**      **SPECIAL PROBLEMS IN PLANT PATHOLOGY**  
Credit to be arranged.  
Research not related to a thesis. **Prerequisites:** PL PA 411/611 or equivalent, and permission of instructor.
- PL PA 807**      **SEMINAR**  
1 cr. (1 and 0) F, S  
Areas of plant pathology and plant physiology not covered by formal courses; relevant literature is reviewed, and material is organized and presented by students. Graded on a pass/fail basis.
- PL PA 809**      **PHYSIOLOGICAL TECHNIQUES IN PLANT PATHOLOGY**  
2 cr. (1 and 3) S (odd numbered years)  
Techniques in separation science; qualitative and quantitative analysis of concern to students in plant pathology and plant physiology. **Prerequisite:** Organic chemistry or permission of instructor.
- PL PA 891**      **MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- PL PA 991**      **DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

### Plant Physiology

N. Dwight Camper, Program Coordinator, Department of Plant Pathology and Physiology

|                  |               |
|------------------|---------------|
| <b>Major</b>     | <b>Degree</b> |
| Plant Physiology | Ph.D.         |

The graduate program in plant physiology is interdisciplinary. Students may select courses and a major area of research from the departments of Agronomy and Soils, Biological Sciences, Forest Resources, Horticulture, and Plant Pathology and Physiology. Dissertation projects are available in the Food Science Department.

*The following courses offered by various departments represent possible electives for the student in plant physiology. Descriptions for all 800-level courses are under the respective departmental headings.*

- AGRON 690**      **BENEFICIAL SOIL ORGANISMS IN PLANT GROWTH**  
3 cr. (3 and 0) F (odd numbered years)
- AGRON 801**      **CROP PHYSIOLOGY AND NUTRITION**  
3 cr. (3 and 0) F (odd numbered years)
- AGRON 812**      **CROP ECOLOGY AND LAND USE**  
3 cr. (3 and 0) F (even numbered years)
- AGRON 820**      **PESTICIDE RESIDUES IN THE ENVIRONMENT**  
3 cr. (3 and 0) S (odd numbered years)
- AGRON 991**      **DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.
- BIOSC 618**      **BIOTECHNOLOGY I: NUCLEIC ACIDS TECHNIQUES**  
(MICRO 618)  
(GEN 618)  
4 cr. (2 and 4) N
- BOT 821**      **INORGANIC PLANT METABOLISM**  
3 cr. (3 and 0) F (odd numbered years)
- BOT 822**      **ORGANIC PLANT METABOLISM**  
3 cr. (3 and 0) S (even numbered years)
- BOT 823**      **PLANT GROWTH AND DEVELOPMENT**  
3 cr. (3 and 0) F (even numbered years)
- BOT 824**      **MODE OF ACTION OF GROWTH SUBSTANCES**  
4 cr. (3 and 3) S (odd numbered years)
- BOT 850**      **PLANT TISSUE AND CELL CULTURE**  
3 cr. (2 and 3) F (odd numbered years)
- BOT 861**      **PLANT CELL BIOLOGY**  
3 cr. (3 and 0) F (odd numbered years)
- BOT 921**      **PLANT PHYSIOLOGY COLLOQUIUM**  
(HORT 921)  
1 cr. (1 and 0)
- FOR 806**      **ADVANCED SILVICULTURE — FOREST TREE GROWTH AND DEVELOPMENT**  
3 cr. (3 and 0) F (odd numbered years)
- FOR 825**      **WOOD CHEMISTRY**  
3 cr. (2 and 3) F (even numbered years)
- FOR 991**      **DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.
- HORT 800**      **TOPICS IN HORTICULTURAL SCIENCE**  
1 cr. (1 and 0)
- HORT 802**      **RESEARCH SYSTEMS IN HORTICULTURE**  
3 cr. (2 and 3) F (even numbered years)
- HORT 806**      **POSTHARVEST PHYSIOLOGY AND HANDLING OF HORTICULTURAL CROPS**  
3 cr. (3 and 0) S (even numbered years)
- HORT 813**      **PHOTOMORPHOGENESIS**  
3 cr. (2 and 2)



|                  |                                                                                                  |
|------------------|--------------------------------------------------------------------------------------------------|
| <b>HORT 814</b>  | <b>ENVIRONMENTAL PLANT STRESS<br/>PHYSIOLOGY</b><br>3 cr. (2 and 2)                              |
| <b>HORT 991</b>  | <b>DOCTORAL DISSERTATION RESEARCH</b><br>Credit to be arranged.                                  |
| <b>PL PA 804</b> | <b>PHYSIOLOGICAL PLANT PATHOLOGY</b><br>3 cr. (3 and 0) F (even numbered years)                  |
| <b>PL PA 809</b> | <b>PHYSIOLOGICAL TECHNIQUES IN PLANT<br/>PATHOLOGY</b><br>2 cr. (1 and 3) S (odd numbered years) |
| <b>PL PA 991</b> | <b>DOCTORAL DISSERTATION RESEARCH</b><br>Credit to be arranged.                                  |
| <b>PL PH 991</b> | <b>DOCTORAL DISSERTATION RESEARCH</b><br>Credit to be arranged.                                  |

### Poultry Science

Bruce Glick, Chair, Department of Poultry Science

| <b>Majors</b>                 | <b>Degrees</b> |
|-------------------------------|----------------|
| Animal and Food<br>Industries | M.S.           |
| Animal Physiology             | M.S., Ph.D.    |
| Nutrition                     | M.S., Ph.D.    |

Applicants with backgrounds in the basic biological sciences and all areas of animal agriculture are accepted.

A specific degree is not offered by this department, but the above degrees are granted through interdepartmental, interdisciplinary programs. At the Ph.D. level, interdisciplinary study is available in nutrition and physiology.

|                |                                                                                                                                                                                                                                                        |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>P S 600</b> | <b>AVIAN PHYSIOLOGY</b><br>3 cr. (3 and 0) S (even numbered years)                                                                                                                                                                                     |
| <b>P S 602</b> | <b>POULTRY MANAGEMENT</b><br>3 cr. (2 and 2) S (odd numbered years)                                                                                                                                                                                    |
| <b>P S 605</b> | <b>SPECIAL TOPICS</b><br>1-4 cr. (1-3 and 0-3)                                                                                                                                                                                                         |
| <b>P S 606</b> | <b>SPECIAL PROBLEMS</b><br>1-3 cr. (0 and 3-9)                                                                                                                                                                                                         |
| <b>P S 651</b> | <b>POULTRY NUTRITION</b><br>2 cr. (2 and 0) F (odd numbered years)                                                                                                                                                                                     |
| <b>P S 653</b> | <b>POULTRY NUTRITION LABORATORY</b><br>1 cr. (0 and 3) F (odd numbered years)                                                                                                                                                                          |
| <b>P S 655</b> | <b>POULTRY PRODUCTS GRADING AND<br/>TECHNOLOGY</b><br>3 cr. (2 and 3) S (odd numbered years)                                                                                                                                                           |
| <b>P S 658</b> | <b>AVIAN MICROBIOLOGY AND<br/>PARASITOLOGY</b><br>4 cr. (3 and 3) F (even numbered years)                                                                                                                                                              |
| <b>P S 660</b> | <b>SEMINAR</b><br>1 cr. (1 and 0)                                                                                                                                                                                                                      |
| <b>P S 804</b> | <b>POULTRY PATHOLOGY</b><br>3 cr. (1 and 6) S (odd numbered years)<br>Etiological agents, prophylaxis and treatment of poultry diseases; laboratory work includes experiments in bacteriology, virology, protozoology and immunology procedures empha- |

sizing isolation and identification of disease-producing agents. **Prerequisite:** P S 458/658 or permission of instructor.

|                |                                                                                                                                                                                                                                                                          |
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| <b>P S 805</b> | <b>SEMINAR</b><br>1 cr. (1 and 0)<br>Report on special topics or original research by students, staff and visiting speakers. May be taken for a maximum of two credits.                                                                                                  |
| <b>P S 825</b> | <b>IMMUNOBIOLOGY</b><br>3 cr. (3 and 0) S<br>Conceptual approach to immunobiology emphasizing the molecular and cellular aspects; classical and current literature is the major source for the discussion/lecture format. <b>Prerequisite:</b> Permission of instructor. |
| <b>P S 891</b> | <b>MASTER'S THESIS RESEARCH</b><br>Credit to be arranged.                                                                                                                                                                                                                |

### Zoology

James M. Colacino, Program Coordinator, Department of Biological Sciences

| <b>Major</b> | <b>Degrees</b> |
|--------------|----------------|
| Zoology      | M.S., Ph.D.    |

Students seeking the master's degree may select either a thesis or nonthesis option. Requirements for the thesis option include 24 semester hours of course work, six hours of research, an acceptable thesis and satisfactory performance in a final oral examination. Requirements for the nonthesis option include 36 semester hours of course work and satisfactory performance in a final comprehensive examination.

Requirements for the Ph.D. degree include written and oral comprehensive examinations, research, a dissertation and satisfactory performance in a final oral defense. Although there is no required course work for the doctorate beyond 18 semester hours of research, breadth and depth of preparation in the life sciences will be expected of each candidate.

|                 |                                                                                                                                                                                                                                                                                                                             |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ZOOL 662</b> | <b>HERPETOLOGY</b><br>3 cr. (2 and 3) F                                                                                                                                                                                                                                                                                     |
| <b>ZOOL 663</b> | <b>ICHTHYOLOGY</b><br>3 cr. (2 and 3) S                                                                                                                                                                                                                                                                                     |
| <b>ZOOL 665</b> | <b>ORNITHOLOGY</b><br>4 cr. (3 and 3) N                                                                                                                                                                                                                                                                                     |
| <b>ZOOL 803</b> | <b>POPULATION DYNAMICS</b><br>4 cr. (2 and 6) N<br>Fundamental mechanisms basic to regulation of natural animal populations; laboratory research project in population dynamics complements theory.                                                                                                                         |
| <b>ZOOL 810</b> | <b>BEHAVIORAL ECOLOGY</b><br>3 cr. (3 and 0) N<br>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. <b>Prerequisites:</b> BIOSC 441/641 and 470/670 or permission of instructor. |
| <b>ZOOL 812</b> | <b>SEMINAR</b><br>1 cr. (1 and 0)<br>Review of current literature in zoology.                                                                                                                                                                                                                                               |



- ZOOL 815**      **PHYSIOLOGICAL ECOLOGY**  
4 cr. (3 and 3) N  
Physiological and biochemical adaptations of invertebrates and vertebrates toward various natural environmental parameters; field trips acquaint students with natural macro- and microenvironments of individual species; field measurements of parameters of the environment are undertaken, and laboratory studies furnish detailed knowledge of various physiological adaptations to these parameters.
- ZOOL 816**      **ADVANCED ECOSYSTEM ANALYSIS**  
4 cr. (3 and 3) N  
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. **Prerequisites:** MTHSC 210 and 605; BIOSC 641 or BOT 846; or permission of instructor.
- ZOOL 818**      **COMMUNITY ECOLOGY**  
4 cr. (3 and 3) N  
Structure and function of ecological communities, emphasizing description of natural communities and evolutionary rules by which they are organized; laboratory applies theory to field problems. **Prerequisites:** MTHSC 108 and 605, BIOSC 641 or BOT 846; or permission of instructor.
- ZOOL 835**      **INTERPRETIVE ELECTRON MICROSCOPY**  
3 cr. (3 and 0) N  
Cell structure as viewed through the electron microscope; characteristic structural features of cells from various tissues and from various organisms at different phylogenetic levels. **Prerequisites:** AN PH 801/BIOSC 801 or BIOSC 632 and 633 or permission of instructor.
- ZOOL 863**      **SPECIAL PROBLEMS**  
1-4 cr.  
Research not related to thesis. **Prerequisite:** Permission of instructor.
- ZOOL 891**      **MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- ZOOL 991**      **DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.



Architecture 40  
City and Regional Planning 41  
Construction Science and Management 43  
English 44  
History 47  
Languages 48  
Performing Arts 49  
Philosophy and Religion 49  
Professional Communication 49  
Visual Arts 49



ARCHITECTURE, ARTS AND HUMANITIES



# COLLEGE OF ARCHITECTURE, ARTS AND HUMANITIES

James F. Barker, Dean

The College of Architecture, Arts and Humanities offers advanced degrees in these areas of study.

Architecture  
City and Regional Planning  
Construction Science and Management  
English  
History  
Professional Communication  
Visual Arts

Courses are offered in art and architectural history, geography, languages, performing arts, philosophy, religion and speech to provide electives for students in other areas.

A vital component of graduate work in architecture and city and regional planning is the Charles E. Daniel Center for Building Research and Urban Studies in Genoa, Italy. The center, which is jointly sponsored by the college and the Clemson Architectural Foundation, is available to all qualified graduate students. Courses of study in the Daniel Center, while under the jurisdiction of the related departments, are administered and taught by the professors-in-residence.

## Architecture

Jose R. Caban, Chair, School of Architecture

|              |                |
|--------------|----------------|
| <b>Major</b> | <b>Degrees</b> |
| Architecture | M.Arch., M.S.  |

The Master of Architecture is a professional degree program. Admission is based on the student's prior academic work and Graduate Record Examinations (GRE) general test scores, as well as creativeness of mind, motivation of spirit and maturity of purpose. Normally a personal interview is required of candidates whose application material has been reviewed favorably by the Admissions Committee. A postbaccalaureate program of preparatory study is available to qualified applicants with backgrounds in areas other than design.

Requirements for the Master of Architecture degree include 45 credits of approved course work and acceptance of a thesis of 15 hours. All candidates for graduation are required to have 1,000 hours of practical experience in an architect's office.

The Master of Science degree in architecture is a postprofessional degree program. Admission is available to students who have a first professional degree in architecture, academic proficiency in prior work, a well-reasoned plan of advanced study, and GRE general test scores. A personal interview is required of all applicants whose application material has been reviewed favorably by the Admissions Committee.

The course work and directed studies required of the Master of Science program may be completed in one academic year, followed by a variable period of time dedicated to the research thesis. Candidates may work in the areas of architecture and health care facilities, environmental issues in architecture, architecture and human perception, and theory and philosophy of architecture. A study plan is determined in consultation with the major advisor and the advisory committee. Credit requirements for the Master of Science degree consist of 24 hours of combined course work and directed studies, and the acceptance of a six-hour research thesis.

|                  |                                         |
|------------------|-----------------------------------------|
| <b>CA AR 603</b> | <b>THE MODERN ARCHITECTURE MOVEMENT</b> |
|                  | 3 cr. (3 and 0)                         |

|                  |                                                                                                                                                                                                                                                                                                  |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CA AR 604</b> | <b>CURRENT DIRECTIONS IN ARCHITECTURE</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                     |
| <b>CA AR 605</b> | <b>AMERICAN ARCHITECTURAL STYLES 1650-1950</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                |
| <b>CA AR 612</b> | <b>ARCHITECTURAL HISTORY RESEARCH</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                         |
| <b>CA AR 614</b> | <b>DESIGN SEMINAR*</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                        |
| <b>CA AR 615</b> | <b>FIELD SKETCHING</b><br>3 cr. (0 and 6)                                                                                                                                                                                                                                                        |
| <b>CA AR 616</b> | <b>FIELD STUDIES IN ARCHITECTURE AND THE RELATED ARTS*</b><br>3 cr. (0 and 9)                                                                                                                                                                                                                    |
| <b>CA AR 624</b> | <b>PRODUCT DESIGN</b><br>3 cr. (0 and 9)                                                                                                                                                                                                                                                         |
| <b>CA AR 625</b> | <b>ENERGY IN ARCHITECTURE</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                 |
| <b>CA AR 626</b> | <b>ARCHITECTURAL COLOR GRAPHICS</b><br>3 cr. (2 and 3)                                                                                                                                                                                                                                           |
| <b>CA AR 627</b> | <b>ADVANCED COLOR GRAPHICS</b><br>3 cr. (2 and 3)                                                                                                                                                                                                                                                |
| <b>CA AR 628</b> | <b>COMPUTER-AIDED DESIGN</b><br>3 cr. (2 and 3)                                                                                                                                                                                                                                                  |
| <b>CA AR 629</b> | <b>ARCHITECTURAL GRAPHICS</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                 |
| <b>CA AR 630</b> | <b>THEORIES AND PHILOSOPHIES OF TECHNOLOGY AND ARCHITECTURE</b><br>3 cr. (3 and 0)                                                                                                                                                                                                               |
| <b>CA AR 685</b> | <b>HEALTH CARE FACILITIES</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                 |
| <b>CA AR 688</b> | <b>HEALTH CARE PROGRAMMING</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                |
| <b>CA AR 801</b> | <b>ARCHITECTURE SEMINAR</b><br>3 cr. (3 and 0)<br>Contemporary issues in the architectural profession.                                                                                                                                                                                           |
| <b>CA AR 802</b> | <b>PHENOMENOLOGY OF ARCHITECTURE</b><br>3 cr. (3 and 0)<br>Basic principles of phenomenological methods as they apply to the theoretical understanding of modern architecture; emphasis is on selected writings of Heidegger, Harries and Norberg-Schulz. <b>Prerequisite:</b> CA AR 803.        |
| <b>CA AR 803</b> | <b>THEORIES OF ARCHITECTURE</b><br>3 cr. (3 and 0)<br>Evolution of architectural theories from Vitruvius to the present; special emphasis on the writings of leading architects and theorists and the impact of these theories on architectural solutions. <b>Prerequisite:</b> Graduate status. |

\* Offered only at the Daniel Center in Genoa, Italy.



- CA AR 804 SEMINAR IN MODERN MASTERS**  
3 cr. (3 and 0)  
In-depth examination of one or more related groups of architects of the 20th century. Content varies from semester to semester (Kahn, Scarpa, Barrigan, Wright, Corbusier, etc.). **Prerequisite:** Graduate status.
- CA AR 805 ARCHITECTURE AND THE CITY**  
3 cr. (3 and 0)  
Seminar examining contemporary theories of urban design and the design of urban buildings; real and ideal visions of cities; their representation, archaeology and iconography (Rossi, Kries, Ungers, Venturi, Duane, etc.).
- CA AR 821 RESEARCH METHODS**  
3 cr. (3 and 0)  
The foundations and procedures of architectural research; alternate research methodologies and their philosophical and epistemological limits. **Prerequisite:** Graduate status.
- CA AR 850 ARCHITECTURE STUDIO\***  
6 cr. (0 and 18)  
Architectural design studies in the context of the Genoa urban setting. May be substituted for CA AR 853 or 854 and for CA AR 857 with permission of advisor.
- CA AR 853 ARCHITECTURE STUDIO**  
6 cr. (0 and 18)  
Architectural design studies with emphasis on selected problem issues.
- CA AR 854 ARCHITECTURE STUDIO**  
6 cr. (0 and 18)  
Architectural design studies involving structured and situational problems. **Prerequisite:** CA AR 853.
- CA AR 857 ARCHITECTURE STUDIO**  
6 cr. (0 and 18)  
Architectural design studies dealing with comprehensive problem-solving situations. **Prerequisite:** CA AR 854.
- CA AR 858 THESIS RESEARCH**  
3 cr. (0 and 9)  
Architectural predesign inventory and analysis for the thesis project. **Prerequisite:** CA AR 854.
- CA AR 859 THESIS MANUSCRIPT**  
1-3 cr. (0 and 3-9)  
Architectural predesign synthesis of research for the thesis project. **Prerequisite:** CA AR 858.
- CA AR 881 DELIVERY OF ARCHITECTURE**  
3 cr. (3 and 0)  
Ethical, legal and business issues in the architectural profession. **Prerequisite:** Professional degree program status.
- CA AR 886 HEALTH CARE COMPONENTS**  
3 cr. (3 and 0)  
Components and service functions of physical and mental health care delivery systems and facilities.

- CA AR 890 DIRECTED STUDIES**  
1-5 cr. (1-5 and 0)  
Special topics in architecture undertaken on an individual basis with faculty guidance. **Prerequisite:** Permission of advisor.
- CA AR 891 THESIS PROJECT**  
3-9 cr. (0 and 9-27)  
Complex architectural project emphasizing design exploration and independent work. Graded on a pass/fail basis. **Prerequisites:** CA AR 857 and 858.

### City and Regional Planning

Donald L. Collins, Chair, Department of Planning and Landscape Architecture

| Major                      | Degree   |
|----------------------------|----------|
| City and Regional Planning | M.C.R.P. |

No specific undergraduate area of study is required; options are available for students with or without a design background.

The Overseas Center for Urban Studies in Genoa, Italy, provides the option of a one-semester overseas study experience in an interdisciplinary program of planning studies, design and fine arts.

Admission to the graduate program requires a bachelor's degree from an accredited college or university; a satisfactory academic record in the last two years of undergraduate work; an on-campus interview (highly recommended); three letters of recommendation; completion of the Graduate Record Examinations; and one three-credit course in statistics, economics and computer applications (highly recommended).

The thesis option\* requires a minimum of 54 hours of course work, including the thesis; a six- to nine-semester-hour planning thesis (only for students who have been approved by the planning faculty and have performed satisfactorily on the comprehensive examination); and a final oral examination requiring satisfactory answers to questions concerning the student's thesis and concentration area.

The nonthesis option\* requires a minimum of 54 hours of course work in the student's prescribed professional curriculum; an approved six-semester-hour terminal paper sequence (only for students who have performed satisfactorily on a comprehensive examination covering the core planning courses); and a final oral examination requiring satisfactory answers to questions concerning the student's terminal paper and concentration area.

- C R P 605 URBAN GENESIS AND FORM**  
3 cr. (3 and 0) N
- C R P 611 INTRODUCTION TO CITY AND REGIONAL PLANNING**  
3 cr. (3 and 0) S
- C R P 615 SMALL CITY AND RURAL PLANNING**  
3 cr. (3 and 0) N
- C R P 672 PLANNING PROCESS AND ADMINISTRATION**  
3 cr. (3 and 0) F
- C R P 673 GOVERNMENT AND PLANNING LAW**  
3 cr. (3 and 0) S
- C R P 683 SEMINAR ON PLANNING COMMUNICATION**  
3 cr. (3 and 0) S

\* Offered only at the Daniel Center in Genoa, Italy.

\* Upon approval of the majority of the faculty, either a thesis or a terminal paper of up to nine semester hours may be permitted with a corresponding reduction in the required course work.



- C R P 812 CITY AND REGIONAL PLANNING THEORY**  
3 cr. (3 and 0) S  
Development of the planning practice and theories of planning process; major topics include 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. **Prerequisite:** Permission of instructor or department chair.
- C R P 822 URBAN SYSTEMS AND DESIGN**  
3 cr. (3 and 0) S  
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 20th century planning theorists. **Prerequisite:** Permission of instructor or department chair.
- C R P 823 SOCIAL POLICY PLANNING AND DELIVERY SYSTEMS**  
3 cr. (3 and 0) S  
Concepts of planning social service delivery systems: basic principles, role of the public sector (at national, state and local levels), components of delivery systems, and methods for planning and evaluation. **Prerequisite:** Permission of instructor.
- C R P 831 PHYSICAL PLANNING STUDIO**  
3 cr. (3 and 0) F  
Working knowledge of natural systems, infrastructure systems, land use activity, social concerns, visual/spatial topics and implementation practice.
- C R P 832 PROBLEMS IN SITE PLANNING**  
3 cr. (1 and 2) F  
Advanced site planning and design concept studies developed through site projects; concentration on industrial, residential and recreational facilities; emphasis on use-specific site analysis and generation of development alternatives. **Prerequisite:** C R P 831.
- C R P 834 GEOGRAPHIC INFORMATION SYSTEMS FOR CITY AND REGIONAL PLANNING**  
3 cr. (3 and 0) S  
Introduction to geographic information systems for planning and related resource management disciplines. Topics include data development and management, spatial analysis techniques, critical review of GIS applications, needs analysis and institutional context, overview of GIS hardware and software, completion of hands-on application project.
- C R P 835 ADVANCED TOPICS IN GEOGRAPHIC INFORMATION SYSTEMS**  
3 cr. (3 and 0) F  
Seminar/laboratory devoted to development and analysis of leading edge GIS capabilities and applications; seminar focus varies from year to year, based upon developments in the GIS field and student interests. **Prerequisite:** C R P 834 or permission of instructor.
- C R P 840 SEMINAR IN COASTAL PLANNING**  
3 cr. (3 and 0) F  
Issues relating to development and conservation of coastal environments, focusing on inherent tradeoffs between growth and environmental quality; ecology and carrying capacity of coastal areas; appropriate management approaches to balance coastal resource demand. **Prerequisite:** Graduate standing.
- C R P 841 SEMINAR IN ENVIRONMENTAL PLANNING**  
3 cr. (3 and 0) S  
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. **Prerequisite:** Graduate standing.
- C R P 853 PLANNING METHODS I: THEORY AND TECHNIQUE**  
3 cr. (0 and 9) F  
Introduction to analytic planning methods; material is drawn principally from the fields of economics, geography, regional science, and city and regional planning. **Prerequisite:** An undergraduate class in microeconomics.
- C R P 854 PLANNING METHODS II: TECHNIQUES AND APPLICATIONS**  
3 cr. (0 and 9) S  
Techniques for planning analysis, including social/economic profiles and projections, impact assessment, land use planning analysis and feasibility studies; computer modeling and simulation; students apply these techniques in studio projects. **Prerequisite:** C R P 853.
- C R P 858 RESEARCH METHODS AND THESIS PLANNING PROPOSAL**  
3 cr. (0 and 9) F  
Preliminary analysis of data to determine most advisable form of terminal presentation within thesis or nonthesis options for Master of City and Regional Planning degree. **Prerequisite:** Permission of faculty.
- C R P 859 PLANNING TERMINAL PROJECT**  
3 cr. (0 and 9) S  
Student selects, with approval of advisor, and conducts research on an individual planning problem of suitable scope. Oral, written and, where appropriate, visual presentation of solution required. Student must enroll during final semester. **Prerequisite:** C R P 858.
- C R P 860 PLANNING STUDIO\***  
3-6 cr. (0 and 9-18) F, S  
Planning studies related to the city of Genoa and its environs. May be substituted for C R P 854, 863 or 865 with approval of credit hours by major advisor.

\* Offered only at the Daniel Center in Genoa, Italy.



- C R P 863** **URBAN AND METROPOLITAN PLANNING STUDIES: STUDIO**  
3-6 cr. (0 and 9-18) N  
Projects pertaining to land use, transportation, urban design, public facilities, public services, capital improvement program, etc., accomplished through individual or small group activity under guidance of planning faculty.
- C R P 866** **COMPREHENSIVE PLANNING STUDIO**  
6 cr. (3 and 9) F  
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. **Prerequisite:** Second year C R P student or permission of instructor.
- C R P 871** **GROWTH MANAGEMENT AND LEGAL ISSUES**  
3 cr. (3 and 0) S  
Basic laws and court cases relating to the comprehensive plan, implementing tools and other aspects of the planning process in the growth management context. **Prerequisites:** C R P 672 and permission of instructor or department chair.
- C R P 872** **HOUSING ISSUES IN THE UNITED STATES**  
3 cr. (3 and 0) N  
Regulation, stimulation, salvage and replacement of housing through public policy administrative procedures; specific housing programs analyzed in detail.
- C R P 881** **QUANTITATIVE METHODS FOR URBAN PLANNING AND POLICY**  
3 cr. (3 and 0) F  
Use of quantitative information for policy analysis in planning and related fields; topics covered include measurement construction, using descriptive and inferential statistics for policy development, and computer use in planning and related professions. **Prerequisite:** Permission of instructor or department chair.
- C R P 882** **SEMINAR IN MATHEMATICAL MODELING FOR URBAN AND REGIONAL PLANNING**  
3 cr. (3 and 0) N  
Mathematical models for analysis of urban systems; predictive and estimating models; optimizing models; simulation; evaluation; theoretical knowledge applied to development of operational empirical models.
- C R P 883** **TECHNIQUES FOR ANALYZING DEVELOPMENT IMPACTS**  
3 cr. (3 and 0) N  
Models and techniques for analyzing development impacts in urban areas and regions; economic, social, physical, energy and fiscal impact methods. Operational knowledge of these techniques will be developed. **Prerequisites:** C R P 881 and permission of instructor.
- C R P 889** **SELECTED TOPICS IN PLANNING**  
3 cr. (3 and 0) F, S  
Topics emphasizing current literature and results of current research. May be repeated for credit. **Prerequisite:** Permission of instructor.

- C R P 890** **DIRECTED STUDIES IN CITY AND REGIONAL PLANNING**  
1-6 cr. (0 and 3-18) F, S, SS  
Student pursues individual professional interests under guidance of city and regional planning program graduate faculty.
- C R P 891** **PLANNING THESIS**  
3-9 cr. S  
Student, working individually, programs a planning problem of appropriate scope and conducts research. Oral, written and, where appropriate, visual presentation of thesis required. **Prerequisite:** Permission of faculty.
- C R P 893** **CITY AND REGIONAL PLANNING INTERNSHIP**  
3-6 cr. (0 and 3-18) F, S, SS  
Twelve weeks of supervised professional employment in an approved planning office or agency. Monthly reports covering student's experience required. Graded on a pass/fail basis. **Prerequisite:** Two semesters of city and regional planning or equivalent.

### Construction Science and Management

Charles Matthewson, Chair, Department of Construction Science and Management

| Major                                  | Degree   |
|----------------------------------------|----------|
| Construction Science<br>and Management | M.C.S.M. |

A bachelor's degree in construction science, construction management, building construction or related areas is required for admission. Applicants from other disciplines may be admitted but may be required to remedy any deficiencies. Acceptance by the Graduate School and the Department of Construction Science and Management is based on performance in previous undergraduate studies, a satisfactory score on the GRE, three letters of recommendation and acceptance by the department Graduate Admissions Committee.

Each student is required to have 800 hours of construction-related experience, which may be no older than six years from date of enrollment in the CSM graduate program.

The thesis option requires a minimum of 36 semester hours of course work in the student's prescribed curriculum, including a thesis based on a construction-related topic; satisfactory performance on a written comprehensive examination covering the student's program of study; and satisfactory performance on a final oral examination relating to the student's thesis and program of study. The student must pass the written comprehensive examination prior to taking the oral examination.

The nonthesis option requires a minimum of 36 semester hours of course work in the student's prescribed curriculum; satisfactory performance on a written comprehensive examination covering the student's program of study; and satisfactory performance on a final oral examination relating to the student's program of study. The student must pass the written comprehensive examination prior to taking the oral examination.

- C S M 655** **REDUCING ADVERSARIAL RELATIONS IN CONSTRUCTION**  
3 cr. (3 and 0)



- C S M 850 INTERNATIONAL CONSTRUCTION\***  
6 cr. (0 and 18)  
Building industries in foreign countries and the methods of managing the construction process within them. This course will be taken by M.C.S.M. students at the Genoa Center in Italy.
- C S M 852 CONSTRUCTION MANAGEMENT RESEARCH**  
3 cr. (2 and 4)  
Research methodology applied to the construction industry. **Prerequisite:** Permission of instructor.
- C S M 860 FINANCIAL PLANNING AND ANALYSIS**  
3 cr. (3 and 0)  
Theory of financial management as it relates to the financial problems faced by the building construction firm. **Prerequisite:** Permission of instructor.
- C S M 861 CONSTRUCTION CONTROL SYSTEMS**  
3 cr. (3 and 0)  
Design and administration of the quality assurance program for large and complex construction projects. **Prerequisite:** Permission of instructor.
- C S M 862 PERSONNEL MANAGEMENT AND NEGOTIATIONS**  
3 cr. (3 and 0)  
The role of management and unions in the construction industry. Topics include contract negotiation, collective bargaining, dispute resolution and management for productivity improvement. **Prerequisite:** Permission of instructor.
- C S M 863 ADVANCED SCHEDULING**  
3 cr. (1 and 6)  
Analysis and control of complex construction projects using advanced techniques for scheduling and resource leveling. **Prerequisite:** Permission of instructor.
- C S M 864 COST ANALYSIS AND MARKETING**  
3 cr. (1 and 6)  
Advanced techniques for cost analysis and their use in marketing construction management, design-build or single-contract project delivery services. **Prerequisite:** Permission of instructor.
- C S M 865 PROJECT MANAGEMENT**  
3 cr. (3 and 0)  
Theory of project administration and control with special emphasis on the role and responsibilities of the resident project representative and the project manager. **Prerequisite:** Permission of instructor.
- C S M 871 ARCHITECTURAL STRUCTURES**  
3 cr. (3 and 0)  
Examination and evaluation of structural systems with emphasis on the compatibility and constraints exerted on architectural design goals. **Prerequisites:** C S M 302 and permission of instructor.

- C S M 877 ADVANCED ARCHITECTURAL ACOUSTICS**  
3 cr. (3 and 0)  
Advanced study of acoustics with emphasis on individual research into design for good hearing and sound control in and around buildings, and applications to design studio work and thesis project; ray tracing for ITDGs, analog models using lasers, evaluations of completed buildings and rigorous analysis of case studies. **Prerequisites:** C S M 403 and permission of instructor.
- C S M 878 LIGHTING FOR ARCHITECTURE**  
3 cr. (3 and 0)  
Interrelationships among the many fields that constitute lighting and its impact on building form, materials and spatial use; the potential contribution of daylight and electric light to human response and performance. **Prerequisites:** C S M 403 and permission of instructor.
- C S M 881 PROFESSIONAL SEMINAR**  
3 cr. (3 and 0)  
New and emerging methods for management of the construction or construction-related firm. **Prerequisite:** Permission of instructor.
- C S M 890 DIRECTED STUDIES**  
3-6 cr.  
Special topics not covered in other courses; emphasis is on field studies, research activities and current developments in building science. **Prerequisite:** Permission of instructor.
- C S M 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.  
With approval of the advisory committee, the student carries on independent research and analysis. The thesis is presented orally and in writing and in strict compliance with the guidelines of the Graduate School.
- C S M 899 CONSTRUCTION SCIENCE AND MANAGEMENT INTERNSHIP**  
No credit  
Consists of 800 hours of verifiable construction-related experience; experience may be no older than six years from date of enrollment in CSM graduate program. Graded on a credit/no credit basis; a letter grade is not given; will not count toward a graduate degree.

### English

Martin J. Jacobi, Program Coordinator, Department of English

**Major**  
English

**Degree**  
M.A.

An applicant for the M.A. degree in English must present at least 12 semester credits of undergraduate English courses beyond the sophomore level; for the M.Ed. degree in secondary education with emphasis in English, an applicant must present at least nine.

M.A. students complete 25 semester credits 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 M.A. program. The nonthesis option requires 37 credits. All English M.A. students must demonstrate a reading knowledge of an approved foreign language.

\* Offered only at the Daniel Center in Genoa, Italy.



M.Ed. students in secondary education with emphasis in English complete a total of 37 graduate credits.

Candidates for the M.A. and M.Ed. degrees also must demonstrate proficiency in composition and pass a comprehensive oral examination.

|                 |                                                                    |                 |                                                                                      |
|-----------------|--------------------------------------------------------------------|-----------------|--------------------------------------------------------------------------------------|
| <b>ENGL 600</b> | <b>THE ENGLISH LANGUAGE</b><br>3 cr. (3 and 0)                     | <b>ENGL 625</b> | <b>THE AMERICAN NOVEL</b><br>3 cr. (3 and 0)                                         |
| <b>ENGL 601</b> | <b>GRAMMAR SURVEY</b><br>3 cr. (3 and 0)                           | <b>ENGL 626</b> | <b>SOUTHERN LITERATURE</b><br>3 cr. (3 and 0)                                        |
| <b>ENGL 603</b> | <b>THE CLASSICS IN TRANSLATION</b><br>3 cr. (3 and 0)              | <b>ENGL 630</b> | <b>MODERN DRAMA</b><br>3 cr. (3 and 0)                                               |
| <b>ENGL 604</b> | <b>CLASSICAL DRAMA</b><br>3 cr. (3 and 0)                          | <b>ENGL 631</b> | <b>MODERN POETRY</b><br>3 cr. (3 and 0)                                              |
| <b>ENGL 605</b> | <b>STUDIES IN ENGLISH LITERATURE TO 1700</b><br>3 cr. (3 and 0)    | <b>ENGL 632</b> | <b>MODERN FICTION</b><br>3 cr. (3 and 0)                                             |
| <b>ENGL 606</b> | <b>STUDIES IN ENGLISH LITERATURE SINCE 1700</b><br>3 cr. (3 and 0) | <b>ENGL 633</b> | <b>THE ANGLO-IRISH LITERARY TRADITION</b><br>3 cr. (3 and 0)                         |
| <b>ENGL 607</b> | <b>THE MEDIEVAL PERIOD</b><br>3 cr. (3 and 0)                      | <b>ENGL 635</b> | <b>LITERARY CRITICISM</b><br>3 cr. (3 and 0)                                         |
| <b>ENGL 608</b> | <b>CHAUCE</b><br>3 cr. (3 and 0)                                   | <b>ENGL 636</b> | <b>FEMINIST LITERARY CRITICISM</b><br>3 cr. (3 and 0)                                |
| <b>ENGL 609</b> | <b>THE EARLIER ENGLISH RENAISSANCE</b><br>3 cr. (3 and 0)          | <b>ENGL 637</b> | <b>DIRECTED STUDIES</b><br>1-3 cr. (1-3 and 0)                                       |
| <b>ENGL 610</b> | <b>DRAMA OF ENGLISH RENAISSANCE</b><br>3 cr. (3 and 0)             | <b>ENGL 645</b> | <b>FICTION WORKSHOP</b><br>3 cr. (3 and 0)                                           |
| <b>ENGL 611</b> | <b>SHAKESPEARE</b><br>3 cr. (3 and 0)                              | <b>ENGL 646</b> | <b>POETRY WORKSHOP</b><br>3 cr. (3 and 0)                                            |
| <b>ENGL 612</b> | <b>STUDIES IN SHAKESPEARE</b><br>3 cr. (3 and 0)                   | <b>ENGL 647</b> | <b>PLAYWRITING WORKSHOP</b><br>3 cr. (3 and 0)                                       |
| <b>ENGL 613</b> | <b>THE LATER ENGLISH RENAISSANCE</b><br>3 cr. (3 and 0)            | <b>ENGL 650</b> | <b>FILM GENRES</b><br>3 cr. (2 and 3)                                                |
| <b>ENGL 614</b> | <b>MILTON</b><br>3 cr. (3 and 0)                                   | <b>ENGL 651</b> | <b>FILM THEORY AND CRITICISM</b><br>3 cr. (2 and 3)                                  |
| <b>ENGL 615</b> | <b>THE RESTORATION AND EIGHTEENTH CENTURY</b><br>3 cr. (3 and 0)   | <b>ENGL 652</b> | <b>GREAT DIRECTORS</b><br>3 cr. (2 and 3)                                            |
| <b>ENGL 616</b> | <b>THE ROMANTIC PERIOD</b><br>3 cr. (3 and 0)                      | <b>ENGL 653</b> | <b>SEXUALITY AND THE CINEMA</b><br>3 cr. (2 and 3)                                   |
| <b>ENGL 617</b> | <b>THE VICTORIAN PERIOD</b><br>3 cr. (3 and 0)                     | <b>ENGL 655</b> | <b>AMERICAN HUMOR</b><br>3 cr. (3 and 0)                                             |
| <b>ENGL 618</b> | <b>THE ENGLISH NOVEL</b><br>3 cr. (3 and 0)                        | <b>ENGL 659</b> | <b>ADVANCED SPECIAL TOPICS IN LANGUAGE, LITERATURE OR CULTURE</b><br>3 cr. (3 and 0) |
| <b>ENGL 622</b> | <b>STUDIES IN AMERICAN LITERATURE I</b><br>3 cr. (3 and 0)         | <b>ENGL 682</b> | <b>AFRICAN AMERICAN FICTION AND NONFICTION</b><br>3 cr. (3 and 0)                    |
| <b>ENGL 623</b> | <b>STUDIES IN AMERICAN LITERATURE II</b><br>3 cr. (3 and 0)        | <b>ENGL 683</b> | <b>AFRICAN AMERICAN POETRY, DRAMA AND FILM</b><br>3 cr. (3 and 0)                    |
| <b>ENGL 624</b> | <b>STUDIES IN AMERICAN LITERATURE III</b><br>3 cr. (3 and 0)       | <b>ENGL 685</b> | <b>COMPOSITION FOR TEACHERS</b><br>3 cr. (3 and 0)                                   |
|                 |                                                                    | <b>ENGL 690</b> | <b>ADVANCED TECHNICAL AND BUSINESS WRITING</b><br>3 cr. (3 and 0)                    |
|                 |                                                                    | <b>ENGL 691</b> | <b>CLASSICAL RHETORIC</b><br>3 cr. (3 and 0)                                         |



|                 |                                                                                                                                                                                                                                                                                                           |                 |                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ENGL 692</b> | <b>MODERN RHETORIC</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                 | <b>ENGL 820</b> | <b>TOPICS IN AMERICAN LITERATURE TO 1865</b><br>3 cr. (3 and 0)<br>Significant authors; works in poetry and prose; literary-intellectual movements such as puritanism, the enlightenment, romanticism and transcendentalism from c. 1607-1865.                                                                                                                                             |
| <b>ENGL 695</b> | <b>TECHNICAL EDITING</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                               | <b>ENGL 823</b> | <b>TOPICS IN AMERICAN LITERATURE SINCE 1865</b><br>3 cr. (3 and 0)<br>Significant authors; works in poetry and prose; literary-intellectual movements such as realism, naturalism, modernism and postmodernism from 1865 to the present.                                                                                                                                                   |
| <b>ENGL 700</b> | <b>CHILDREN'S LITERATURE FOR TEACHERS</b><br>3 cr. (3 and 0)<br>Literature for preschool through junior high.                                                                                                                                                                                             | <b>ENGL 831</b> | <b>SPECIAL TOPICS</b><br>3 cr. (3 and 0)<br>Topics not covered in other courses.                                                                                                                                                                                                                                                                                                           |
| <b>ENGL 701</b> | <b>LITERATURE FOR TEACHERS</b><br>3 cr. (3 and 0)<br>Literary studies of special interest to secondary school teachers.                                                                                                                                                                                   | <b>ENGL 832</b> | <b>TOPICS IN SCIENTIFIC, TECHNICAL AND BUSINESS WRITING</b><br>3 cr. (3 and 0)<br>Seminar courses in areas such as professional editing and publishing, writing for government and industry, teaching technical writing, and writing for journals, magazines and newspapers.                                                                                                               |
| <b>ENGL 702</b> | <b>WRITING PROJECTS</b><br>3 cr. (3 and 0)<br>Exchange and development of methods for teaching writing that have a firm theoretical foundation.                                                                                                                                                           | <b>ENGL 835</b> | <b>TOPICS IN LITERARY CRITICISM</b><br>3 cr. (3 and 0)<br>Principal statements of literary critics from the classical era to the present.                                                                                                                                                                                                                                                  |
| <b>ENGL 800</b> | <b>INTRODUCTION TO RESEARCH</b><br>1 cr. (1 and 0)<br>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. | <b>ENGL 837</b> | <b>TOPICS IN LINGUISTICS</b><br>3 cr. (3 and 0)<br>Concepts of traditional and modern grammarians; development of English language.                                                                                                                                                                                                                                                        |
| <b>ENGL 801</b> | <b>TOPICS IN COMPOSITION</b><br>3 cr. (3 and 0)<br>Principal theories and practices in modern grammar, stylistics and semantics related to teaching composition.                                                                                                                                          | <b>ENGL 840</b> | <b>SELECTED TOPICS</b><br>3 cr. (3 and 0)<br>Tutorial work in linguistics or American, British or European literature not offered in other courses. <b>Prerequisite:</b> Permission of director of graduate studies.                                                                                                                                                                       |
| <b>ENGL 802</b> | <b>TOPICS IN LITERARY GENRES</b><br>3 cr. (3 and 0)<br>Principal literary genres.                                                                                                                                                                                                                         | <b>ENGL 850</b> | <b>RESEARCH AND STUDIES IN SCIENTIFIC, BUSINESS AND TECHNICAL WRITING</b><br>3 cr. (3 and 0)<br>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. <b>Prerequisite:</b> Graduate standing.    |
| <b>ENGL 803</b> | <b>TOPICS IN RHETORICAL THEORY</b><br>3 cr. (3 and 0)<br>Major rhetorical theories, figures and historical movements.                                                                                                                                                                                     | <b>ENGL 851</b> | <b>SEMINAR IN PROFESSIONAL WRITING</b><br>3 cr. (3 and 0)<br>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. <b>Prerequisite:</b> Graduate standing. |
| <b>ENGL 805</b> | <b>TOPICS IN MEDIEVAL LITERATURE</b><br>3 cr. (3 and 0)<br>Principal works in verse and prose from c. 1100-1500.                                                                                                                                                                                          | <b>ENGL 853</b> | <b>VISUAL COMMUNICATIONS</b><br>3 cr. (3 and 0)<br>Understanding the language of images used in textual and extratextual communication; theories of perception, methods of visual persuasion, gender analysis, and cognitive and aesthetic                                                                                                                                                 |
| <b>ENGL 808</b> | <b>TOPICS IN RENAISSANCE AND RESTORATION LITERATURE</b><br>3 cr. (3 and 0)<br>Principal works in verse and prose from c. 1500-1700.                                                                                                                                                                       |                 |                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>ENGL 811</b> | <b>TOPICS IN NEOCLASSIC AND ROMANTIC LITERATURE</b><br>3 cr. (3 and 0)<br>Principal works in verse and prose from c. 1700-1832.                                                                                                                                                                           |                 |                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>ENGL 814</b> | <b>TOPICS IN VICTORIAN AND MODERN BRITISH LITERATURE</b><br>3 cr. (3 and 0)<br>Principal works in verse and prose from c. 1832 to present.                                                                                                                                                                |                 |                                                                                                                                                                                                                                                                                                                                                                                            |



philosophies of visual rhetoric. **Prerequisite:** Graduate standing.

- ENGL 854 TEACHING PROFESSIONAL WRITING**  
3 cr. (3 and 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. **Prerequisite:** Graduate standing.
- ENGL 885 COMPOSITION THEORY**  
3 cr. (3 and 0)  
Teaching college-level courses, stressing contemporary composition theory, research and practice. **Prerequisite:** Graduate standing.
- ENGL 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- ENGL 892 MASTER'S PROJECT**  
1-3 cr.  
Required for the nonthesis option of the M.A. in professional communication; completion of course requires writing a document for the professional world and keeping a log or journal as a record of the project; student presents the project to advisor(s). Credit to be arranged. A maximum of three credits may be counted toward the degree.
- SPCH 664 ADVANCED ORGANIZATIONAL COMMUNICATION**  
3 cr. (3 and 0)

## History

Edwin E. Moise, Program Director, Department of History

| Major   | Degree |
|---------|--------|
| History | M.A.   |

The M.A. in history requires 30 credits in courses numbered 600 or above, at least 12 of which must be earned in 800-level courses, and a minimum of six credits in graduate thesis research. 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 or oral or a combination of the two forms, is required of all candidates.

- HIST 600 STUDIES IN UNITED STATES HISTORY**  
3 cr. (3 and 0)
- HIST 638 PROBLEMS IN AFRICAN HISTORIOGRAPHY AND METHODOLOGY**  
3 cr. (3 and 0)
- HIST 640 STUDIES IN LATIN AMERICAN HISTORY**  
3 cr. (3 and 0)
- HIST 650 STUDIES IN ANCIENT HISTORY**  
3 cr. (3 and 0)
- HIST 660 STUDIES IN BRITISH HISTORY**  
3 cr. (3 and 0)
- HIST 670 STUDIES IN EARLY EUROPEAN HISTORY**  
3 cr. (3 and 0)

- HIST 671 STUDIES IN MODERN EUROPEAN HISTORY**  
3 cr. (3 and 0)
- HIST 692 STUDIES IN DIPLOMATIC HISTORY**  
3 cr. (3 and 0)
- HIST 693 STUDIES IN SOCIAL HISTORY**  
3 cr. (3 and 0)
- HIST 694 STUDIES IN COMPARATIVE HISTORY**  
3 cr. (3 and 0)
- HIST 695 STUDIES IN THE HISTORY OF IDEAS**  
3 cr. (3 and 0)
- HIST 696 STUDIES IN LEGAL HISTORY**  
3 cr. (3 and 0)
- HIST 697 STUDIES IN THE HISTORY OF SCIENCE AND TECHNOLOGY**  
3 cr. (3 and 0)
- HIST 700 UNITED STATES THROUGH THE CIVIL WAR**  
3 cr. (3 and 0)  
Problems in United States history through 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 permission of graduate program director.
- HIST 710 UNITED STATES SINCE 1865**  
3 cr. (3 and 0)  
Problems in United States 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 permission of graduate program director.
- HIST 720 SOUTHERN HISTORY**  
3 cr. (3 and 0)  
Problems in Southern history with attention given to bibliography and teaching methods. Primarily for Master of Education candidates, but open to all graduate students. May be repeated with permission of graduate program director.
- HIST 760 BRITISH HISTORY**  
3 cr. (3 and 0)  
Problems in the history of Great Britain and the British Empire with attention given to bibliography and teaching methods. Primarily for Master of Education candidates, but open to all graduate students. May be repeated with permission of graduate program director.
- HIST 770 EUROPE TO THE 18TH CENTURY**  
3 cr. (3 and 0)  
Problems in European history to 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 permission of graduate program director.



- HIST 775 EUROPE SINCE THE 18TH CENTURY**  
3 cr. (3 and 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 permission of graduate program director.
- HIST 790 HISTORICAL AREA STUDIES**  
3 cr. (3 and 0)  
Problems in the history of Africa, Asia, Latin America or the Middle East with attention given to bibliography and teaching methods. Primarily for Master of Education candidates, but open to all graduate students. May be repeated with permission of graduate program director.
- HIST 800 SEMINAR IN UNITED STATES HISTORY**  
3 cr. (3 and 0)  
Training in historical research and writing. May be repeated for credit with approval of graduate program director.
- HIST 830 SEMINAR IN ASIAN HISTORY**  
3 cr. (3 and 0)  
Training in historical research and writing with focus on Asian history. May be repeated for credit with approval of graduate program director.
- HIST 840 SEMINAR IN LATIN AMERICAN HISTORY**  
3 cr. (3 and 0)  
Training in historical research and writing with focus on Latin American history. May be repeated for credit with approval of graduate program director.
- HIST 860 SEMINAR IN BRITISH HISTORY**  
3 cr. (3 and 0)  
Training in historical research and writing. May be repeated for credit with approval of graduate program director.
- HIST 870 SEMINAR IN EUROPEAN HISTORY**  
3 cr. (3 and 0)  
Training in historical research and writing. May be repeated for credit with approval of graduate program director.
- HIST 880 SPECIAL TOPICS IN HISTORY**  
3 cr. (3 and 0)  
Training in historical research and writing. May be repeated for credit with approval of graduate program director.
- HIST 881 HISTORIOGRAPHY**  
3 cr. (3 and 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 cr. (3 and 0)  
Critical study of a historical topic, selected according to needs of student and with approval of graduate program director. May be repeated for credit with the approval of the graduate program director.
- HIST 887 ARCHIVAL MANAGEMENT: AN INTRODUCTION**  
3 cr. (3 and 0)  
Introduction to basic concepts of archival theory and management.
- HIST 888 HISTORICAL AND TEXTUAL EDITING**  
3 cr. (3 and 0)  
Practical, intensive course introduces techniques for handling archival materials and preparing scholarly editions.
- HIST 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- HIST 893 PRACTICUM IN ARCHIVAL MANAGEMENT**  
3 cr. (0 and 9)  
Hands-on experience in the operations of an archival program, including acquisitions, arrangements, descriptions, conservation and reference service. **Prerequisite:** HIST 887 or permission of instructor.
- HIST 894 PRACTICUM IN HISTORICAL EDITING**  
3 cr. (3 and 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. **Prerequisite:** HIST 888.
- GEOG 601 STUDIES IN REGIONAL GEOGRAPHY**  
3 cr. (3 and 0)
- GEOG 610 GEOGRAPHY OF THE AMERICAN SOUTH**  
3 cr. (3 and 0)
- GEOG 620 HISTORICAL GEOGRAPHY OF THE UNITED STATES**  
3 cr. (3 and 0)
- GEOG 700 TOPICS IN GEOGRAPHY**  
3 cr. (3 and 0)  
Intensive study of a topic in geography such as world regions, American minorities, the historical geography of the United States or the geography of South Carolina. Restricted to elementary and secondary school teachers. May be repeated for credit with departmental permission. Permission of department.
- Languages**  
Samuel C. King, Chair, Department of Languages
- Advanced degrees are not awarded in languages. Courses are offered to provide electives for students in other areas.
- FR 699 SELECTED TOPICS IN FRENCH LITERATURE**  
3 cr. (3 and 0)
- GER 698 INDEPENDENT STUDY**  
1-3 cr. (1-3 and 0)
- SPAN 699 SPANISH LITERATURE, LANGUAGE AND CULTURE**  
3 cr. (3 and 0)



*Two special courses are offered in French and German for graduate students preparing for the language examination.*

- FR 151 FRENCH FOR GRADUATE STUDENTS**  
3 cr. (3 and 0)
- GER 151 GERMAN FOR GRADUATE STUDENTS**  
3 cr. (3 and 0)

### Performing Arts

Clifton S. Egan, Chair, Department of Performing Arts

Advanced degrees are not awarded in performing arts. Courses are offered to provide electives for students in other areas.

- THEA 672 IMPROVISATION: INTERPRETING AND DEVELOPING TEXTS**  
3 cr. (3 and 0)
- THEA 699 INDEPENDENT STUDIES**  
1-3 cr. (1-3 and 0)

### Philosophy and Religion

Stuart Silvers, Chair, Department of Philosophy and Religion

Advanced degrees are not awarded in philosophy and religion. Courses are offered to provide electives for students in other areas.

- PHIL 601 STUDIES IN THE HISTORY OF PHILOSOPHY**  
3 cr. (3 and 0)
- PHIL 602 TOPICS IN PHILOSOPHY**  
3 cr. (3 and 0)
- PHIL 825 ADVANCED STUDIES IN THE PHILOSOPHY OF SCIENCE**  
3 cr. (3 and 0) F  
Inquiry into the conceptual foundations of empirical science, in particular, the often tacit presuppositions of substantive and methodological assumptions shared by a scientific community.
- REL 601 STUDIES IN BIBLICAL LITERATURE AND RELIGION**  
3 cr. (3 and 0)
- REL 602 STUDIES IN RELIGION**  
3 cr. (3 and 0)

### Professional Communication

Susan J. Hilligoss, Program Coordinator, Department of English

| Major                      | Degree |
|----------------------------|--------|
| Professional Communication | M.A.   |

The Department of English offers a Master of Arts degree in professional communication. The program accommodates students with undergraduate majors in technical and scientific fields, as well as those with humanities and business degrees.

The M.A. in professional communication requires 30 credit hours beyond the B.A. or B.S. degree, including core courses and four or five electives from a list of recommended courses. Candidates must demonstrate a reading knowledge of a foreign language and pass a qualifying examination on a reading list before undertaking the required thesis or project. The thesis is based on research of a problem in professional communication. The project

is a document written for the professional world with a log or journal kept as a record of the project's progress.

Applicants must hold a degree in any field from an accredited college or university, with a 3.0 GPR on a 4-point scale; submit a satisfactory score on the general portion of the Graduate Record Examinations; submit two letters of recommendation from individuals familiar with the candidate's academic work and/or work experience; and submit a brief resumé and an autobiographical essay of not more than 500 words discussing educational goals and demonstrating proficiency for a writing program.

Courses for this program are offered by the Department of English.

### Visual Arts

John T. Acorn, Chair, Department of Art

| Major       | Degree |
|-------------|--------|
| Visual Arts | M.F.A. |

The graduate program in visual arts leading to the Master of Fine Arts degree admits a limited number of talented and creative candidates on a competitive basis. The candidate must have a bachelor's degree from an accredited college or university with a major in visual arts, liberal arts, fine arts or architecture. Especially well-qualified persons may be accepted from other degree backgrounds. A satisfactory academic record in the last 60 major credit hours of undergraduate work is required. A portfolio documentation of 15-20 creative works must be submitted, representing the chosen field of study. The portfolio may include slides, photographs, films, other documentation or the original works. A personal interview, letters of recommendation, a statement of intent regarding the applicant's interest and direction in pursuing the graduate degree must be submitted.

Students are required to complete a minimum of 45 credit hours in the student's professional curriculum, including 36 hours of ART 600- and 800-level courses; 9 hours in the history of art; a 15-credit-hour thesis culminating in satisfactory completion of a written documentary of the "thesis exhibition"; and an oral examination by the Graduate Committee.

- ART 605 ADVANCED DRAWING**  
3 cr. (0 and 6)
- ART 607 ADVANCED PAINTING**  
3 cr. (0 and 6)
- ART 609 ADVANCED SCULPTURE**  
3 cr. (0 and 6)
- ART 611 ADVANCED PRINTMAKING**  
3 cr. (0 and 6)
- ART 613 ADVANCED PHOTOGRAPHY**  
3 cr. (0 and 6)
- ART 615 ADVANCED GRAPHIC DESIGN**  
3 cr. (0 and 6)
- ART 617 ADVANCED CERAMIC ARTS**  
3 cr. (0 and 6)
- ART 620 SELECTED TOPICS IN ART**  
3 cr. (0 and 6)
- ART 690 DIRECTED STUDIES**  
1-5 cr. (0 and 2-10)



- ART 805 VISUAL ARTS SEMINAR ON THEORIES AND PRACTICE I**  
3 cr. (3 and 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 cr. (3 and 0)  
Continuation of ART 805.
- ART 840 VISUAL ARTS STUDIO**  
3-6 cr. (0 and 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 cr. (0 and 9)  
Concentrated and advanced work in ceramics, drawing, painting, printmaking, sculpture, photography, graphic design or multimedia. **Prerequisite:** Permission of department chair or instructor.
- ART 851 VISUAL ARTS STUDIO**  
3-6 cr. (0 and 9)  
Continuation of ART 850. May be repeated for maximum of six credits. **Prerequisite:** Permission of department chair or instructor.
- ART 870 VISUAL ARTS STUDIO**  
6 cr. (0 and 16)  
Advanced theory; directed research in art criticism; applied work in ceramic arts, drawing, painting, sculpture, photography, graphic design or multimedia. **Prerequisite:** Permission of department chair or instructor.
- ART 871 VISUAL ARTS STUDIO**  
3-6 cr. (0 and 8-16)  
Continuation of ART 870. May be repeated for maximum of six credits. **Prerequisite:** Permission of department chair or instructor.
- ART 880 VISUAL ARTS STUDIO**  
3-15 cr. (0 and 6-30)  
Continuation of ART 871. May be repeated for maximum of 15 credits. **Prerequisite:** Permission of department chair or instructor.
- ART 891 MASTER'S THESIS RESEARCH**  
3-15 cr. (0 and 6-30)  
May be repeated for maximum of 15 credits. **Prerequisite:** Permission of department chair or instructor.

*No degrees are offered in art and architectural history. Courses are offered to provide electives for students in other areas.*

- A A H 611 DIRECTED RESEARCH IN ART HISTORY I**  
3 cr. (3 and 0)
- A A H 612 DIRECTED RESEARCH IN ART HISTORY II**  
3 cr. (3 and 0)
- A A H 617 STUDIES IN THE ART AND ARCHITECTURE OF THE ANCIENT WORLD I**  
3 cr. (3 and 0)

- A A H 618 STUDIES IN THE ART AND ARCHITECTURE OF THE ANCIENT WORLD II**  
3 cr. (3 and 0)
- A A H 619 STUDIES IN THE ART AND ARCHITECTURE OF THE EARLY MIDDLE AGES**  
3 cr. (3 and 0)
- A A H 620 STUDIES IN THE ART AND ARCHITECTURE OF THE LATE MIDDLE AGES**  
3 cr. (3 and 0)
- A A H 623 STUDIES IN THE ART AND ARCHITECTURE OF THE RENAISSANCE I**  
3 cr. (3 and 0)
- A A H 624 STUDIES IN THE ART AND ARCHITECTURE OF THE RENAISSANCE II**  
3 cr. (3 and 0)
- A A H 625 ARCHITECTURE OF THE TECHNOLOGICAL REVOLUTION: 1685-1865**  
3 cr. (3 and 0)
- A A H 627 EIGHTEENTH CENTURY VISUAL ARTS**  
3 cr. (3 and 0)
- A A H 628 NINETEENTH CENTURY VISUAL ARTS**  
3 cr. (3 and 0)
- A A H 629 STUDIES IN THE ART AND ARCHITECTURE OF INDIA AND THE FAR EAST**  
3 cr. (3 and 0)
- A A H 630 TWENTIETH CENTURY ART I**  
3 cr. (3 and 0)
- A A H 632 TWENTIETH CENTURY ART II**  
3 cr. (3 and 0)
- A A H 815 ART AND ARCHITECTURAL HISTORY SEMINAR I**  
3 cr. (3 and 0)  
Particular aspect of period of art/architectural history. **Prerequisite:** Permission of instructor.
- A A H 816 ART AND ARCHITECTURAL HISTORY SEMINAR II**  
3 cr. (3 and 0)  
Continuation of A A H 815.



|                                  |    |                                   |    |
|----------------------------------|----|-----------------------------------|----|
| Agricultural Engineering         | 69 | Environmental Systems Engineering | 58 |
| Bioengineering                   | 52 | Environmental Toxicology          | 61 |
| Ceramic Engineering              | 54 | Hydrogeology                      | 61 |
| Chemical Engineering             | 55 | Industrial Engineering            | 63 |
| Chemistry                        | 70 | Management Science                | 83 |
| Civil Engineering                | 72 | Materials Science and Engineering | 56 |
| Computer Engineering             | 75 | Mathematical Sciences             | 83 |
| Computer Science                 | 77 | Mechanical Engineering            | 65 |
| Electrical Engineering           | 80 | Physics                           | 89 |
| Engineering Graphics             | 62 | Textile and Polymer Science       | 68 |
| Engineering Mechanics            | 62 | Textile Chemistry                 | 68 |
| Environmental Science and Policy | 58 | Textile Science                   | 68 |





## COLLEGE OF ENGINEERING AND SCIENCE

Thomas M. Keinath, Dean

The College of Engineering and Science offers advanced degrees in these areas of study.

Agricultural Engineering\*  
Bioengineering  
Ceramic Engineering  
Chemical Engineering  
Chemistry  
Civil Engineering  
Computer Engineering  
Computer Science  
Electrical Engineering  
Engineering Mechanics  
Environmental Systems Engineering  
Environmental Toxicology\*\*  
Hydrogeology  
Industrial Engineering  
Management Science\*\*\*  
Materials Science and Engineering  
Mathematical Sciences  
Mechanical Engineering  
Physics  
Textile and Polymer Science  
Textile Chemistry  
Textile Science

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

The college offers cooperative graduate programs in which semesters of on-campus study are alternated with work assignments in industry.

The Clemson University Master of Engineering Program at The Citadel offers high quality graduate engineering education in the South Carolina Lowcountry. Currently courses are offered in civil engineering in the subject areas of structural, water resources and construction engineering. The Master of Science degree program in civil engineering, both thesis and nonthesis options, is offered at The Citadel.

Information about courses and registration can be obtained by writing to Clemson University Master of Engineering Program at The Citadel, P.O. Box 12099, Charleston, SC 29422-2099, or by calling (803) 953-2242.

### *School of Chemical and Materials Engineering*

R. Larry Dooley, Director

Bioengineering  
Ceramic Engineering  
Chemical Engineering  
Materials Science and Engineering

\* This program is administered jointly by the College of Engineering and Science and the College of Agriculture, Forestry and Life Sciences. The degrees are awarded by the College of Engineering and Science.

\*\* This program is administered jointly by the College of Agriculture, Forestry and Life Sciences and the College of Engineering and Science.

\*\*\* This program is administered jointly by the Department of Management (College of Professional Studies) and the Department of Mathematical Sciences. The Ph.D. is awarded by the College of Professional Studies.

## Bioengineering

R. Larry Dooley, Chair, Department of Bioengineering

Major  
Bioengineering

Degrees  
M.S., Ph.D.

Students enrolling in this program usually have a strong background in the more traditional engineering disciplines. Some background in general biology and physiology is recommended but is not a prerequisite. Students with degrees in science may be considered for admission if they can demonstrate proficiency in certain prescribed engineering courses.

The master's degree curriculum offers both a thesis and a nonthesis option. The thesis option requires a minimum of 30 semester hours including six semester hours of research. The nonthesis option requires a minimum of 33 semester hours including six semester hours of nonthesis research, special topics or internship, and a report. Both options require a final examination.

The faculty in bioengineering is augmented by adjunct medical faculty, and most research programs are conducted in collaboration with medical, clinical or research-oriented institutions. All students have some direct experience with an appropriate aspect of this medical involvement. A three-month clinical internship is available to all students through the Bioengineering Alliance of South Carolina.

**BIO E 650**      **SPECIAL TOPICS IN BIOMEDICAL ENGINEERING**  
1-4 cr.

**BIO E 800**      **SEMINAR IN BIOENGINEERING RESEARCH**  
1 cr. (2 and 0)  
Original research in bioengineering; weekly one hour seminar associated with weekly recitation covering seminar preparation, presentation, professional writing, bioengineering ethics and related topics. Graded on a pass/fail basis.

**BIO E 801**      **BIOMATERIALS**  
3 cr. (3 and 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 are emphasized. **Prerequisite:** M E 204, CR E 310 or equivalent, or permission of instructor.

**BIO E 802**      **COMPATIBILITY OF BIOMATERIALS**  
3 cr. (1 and 6)  
Techniques employed in 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 cr. (3 and 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. **Prerequisite:** Permission of instructor.



- BIO E 804 METALLIC AND CERAMIC IMPLANT MATERIALS**  
3 cr. (3 and 0)  
Interaction between implant material and host tissue, selection of materials for different applications, influences of material and host tissue performance on implant design and on in vitro testing of implant materials and devices. **Prerequisites:** CR E 310, BIO E 801 and permission of instructor.
- BIO E 805 COMPOSITE BIOMATERIALS**  
3 cr. (3 and 0)  
Mechanics of fiber-reinforced composite materials and their use in the design of structural orthopaedic implants. Topics covered include macro- and micro-mechanics, materials considerations, biocompatibility, diffusion, environmental resistance, aging, sterilization and fracture behavior. **Prerequisite:** BIO E 820 or permission of instructor.
- BIO E 812 ORTHOPAEDIC ENGINEERING AND PATHOLOGY**  
3 cr. (3 and 0)  
Interdisciplinary study of orthopaedic cases (bone growth, bone remodeling, osteoarthritis, implant fixation and joint replacements); biomechanical, biomaterials and clinical diagnosis of failed implants (total joints, fracture fixation and spinal instrumentation); basic concepts of orthopaedic pathology for engineers. **Prerequisites:** BIO E 801, 802, 820 and 882 or permission of instructor.
- BIO E 820 STRUCTURAL BIOMECHANICS**  
3 cr. (3 and 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; orthopaedic prostheses and braces; effect of vibration and impact on the body; mathematical and other models of the body. **Prerequisite:** Permission of instructor.
- BIO E 821 HUMAN DYNAMICS**  
3 cr. (3 and 1)  
Elements of kinetics and kinematics, anthropometry, body segment parameters, link segment model development and synthesis of human movement, muscle mechanics, sports mechanics, blood flow and other delivery systems, organ motion and other topics of particular interest to students, all with reference to the human body in health and disease. **Prerequisites:** BIO E 820 or equivalent and permission of instructor.
- BIO E 823 ARTIFICIAL CARDIAC ASSISTANCE AND REPLACEMENT**  
2 cr. (2 and 0)  
Medical and bioengineering aspects of artificial hearts and cardiac assist devices; physiology and pathological aspects of patients with need for such devices; history of artificial heart development; design aspects of current devices; state of the art in animal experiments and human preliminary trials. **Prerequisites:** BIO E 882 and BIOSC 459/659.
- BIO E 840 CREATIVE BIOMEDICAL ENGINEERING DESIGN**  
3 cr. (2 and 2)  
Design philosophy; product liability; need analysis and specifications; feasibility studies; patent law; creativity and inventions; modeling and decision making; design of devices and systems; computer-aided design and manufacture (CAD/CAM); optimization; reliability; human factors; students complete biomedical design project with hands-on CAD/CAM experience. **Prerequisite:** Permission of instructor.
- BIO E 847 ELEMENTS OF BIOENGINEERING**  
4 cr. (4 and 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. **Prerequisite:** BIOSC 459/659.
- BIO E 850 SPECIAL TOPICS IN BIOMEDICAL ENGINEERING**  
1-4 cr. (0-4 and 12-0)  
Directed study of advanced topics in bioengineering intended to develop in-depth areas of particular student interest. Credit may be earned for more than one semester. **Prerequisite:** Permission of instructor.
- BIO E 870 BIOINSTRUMENTATION**  
3 cr. (2 and 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 882 BIOMATERIALS IMPLANTOLOGY**  
4 cr. (2 and 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. **Prerequisite:** BIOSC 459/659 or equivalent.
- BIO E 890 INTERNSHIP**  
1-5 cr. (0 and 8-40)  
Observation and assignment in a medical college, dental college, hospital, veterinary clinic, dental clinic, health service or industrial department. Credit to be arranged. **Prerequisite:** Permission of department head.
- BIO E 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.



**BIO E 892**      **NONTHESIS INDEPENDENT STUDY IN BIOENGINEERING**  
1-6 cr.  
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. Graded on a pass/fail basis.

**BIO E 991**      **DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

*The following courses offered by various departments represent possible electives for the student in bioengineering. Descriptions for all 800-level courses are under the respective departmental headings.*

**AN PH 801**      **ELECTRON MICROSCOPY OF BIOLOGICAL SPECIMENS**  
(BIOSC 801)      3 cr. (1 and 6) F, S

**BIOCH 606**      **PHYSIOLOGICAL CHEMISTRY**  
3 cr. (3 and 0)

**BIOCH 623**      **PRINCIPLES OF BIOCHEMISTRY**  
3 cr. (3 and 0)

**BIOSC 659**      **SYSTEMS PHYSIOLOGY**  
3 cr. (3 and 0)

**BIOSC 661**      **CELL BIOLOGY**  
3 cr. (3 and 0)

**CH E 820**      **COMPOSITE POLYMERIC MATERIALS**  
(T C 820)      3 cr. (3 and 0) N

**E M 630**      **MECHANICS OF COMPOSITE MATERIALS**  
3 cr. (3 and 0)

**E M 831**      **THEORY OF ELASTICITY I**  
3 cr. (3 and 0)

**EX ST 801**      **STATISTICAL METHODS**  
4 cr. (3 and 3) F, S

**EX ST 805**      **DESIGN AND ANALYSIS OF EXPERIMENTS**  
3 cr. (3 and 0) F, S

**P S 825**      **IMMUNOBIOLOGY**  
3 cr. (3 and 0) S

## Ceramic Engineering

H. David Leigh III, Chair, Department of Ceramic Engineering

|                     |                      |
|---------------------|----------------------|
| <b>Major</b>        | <b>Degrees</b>       |
| Ceramic Engineering | M.Engr., M.S., Ph.D. |

Enrollment is open to students with baccalaureate degrees in any branch of engineering and to those with degrees in chemistry or physics who have credit for certain prescribed courses in engineering.

The M.S. degree program requires a minimum of 30 hours of graduate credit, including six hours of thesis research. The Ph.D. degree program requires 18 hours of dissertation research.

**CR E 602**      **SOLID STATE CERAMICS**  
3 cr. (3 and 0)

**CR E 603**      **GLASSES**  
3 cr. (3 and 0)

**CR E 604**      **CERAMIC COATINGS**  
3 cr. (3 and 0)

**CR E 610**      **ANALYTICAL PROCESSES**  
3 cr. (2 and 3)

**CR E 614**      **PROCESSING OF CERAMICS**  
3 cr. (3 and 0)

**CR E 616**      **ELECTRONIC CERAMICS**  
3 cr. (3 and 0)

**CR E 617**      **INDUSTRIAL FUELS AND COMBUSTION**  
3 cr. (3 and 0)

**CR E 618**      **PROCESS CONTROL**  
3 cr. (3 and 0)

**CR E 619**      **SCIENCE OF ENGINEERING MATERIALS I**  
3 cr. (3 and 0)

**CR E 620**      **SCIENCE OF ENGINEERING MATERIALS II**  
3 cr. (3 and 0)

**CR E 630**      **FINE PARTICLE PROCESSING IN CERAMIC SYSTEMS**  
3 cr. (3 and 0)

**CR E 690**      **SPECIAL TOPICS IN CERAMIC ENGINEERING**  
1-3 cr. (1-3 and 0)

**CR E 701**      **SPECIAL PROBLEMS**  
1-3 cr. (1-3 and 0)  
Practical problems in ceramic engineering analysis or design; students are assigned individual problems with topics varying from year to year in keeping with developments, interests and experience of students and instructor. May be repeated for additional credit.

**CR E 800**      **CERAMIC ENGINEERING SEMINAR**  
1 cr. (1 and 0)  
Discussions and presentations of current topics of ceramic science and engineering by students, faculty members and guest speakers. Required of all graduate students. Graded on a pass/fail basis.

**CR E 807**      **SPECIALIZED CERAMICS**  
3 cr. (3 and 0)  
Student makes advanced study of one of the following: structural products, refractories, whitewares, abrasives, enamels, glass, cements or raw materials processing.

**CR E 809**      **HIGH-TEMPERATURE MATERIALS**  
3 cr. (3 and 0)  
Properties of oxides, carbides, nitrides, borides and silicides; obtainment and measurement of high temperatures; measurement of properties at high temperatures.

**CR E 814**      **CERAMIC PHYSICAL PROCESSING**  
3 cr. (3 and 0)  
Role of physical processing in determining structure and composition of products.



- CR E 815 COLLOIDAL AND SURFACE SCIENCE**  
3 cr. (3 and 0)  
Theory and application of colloidal and surface chemistry to ceramic materials and processes.
- CR E 816 CONSTITUTION AND STRUCTURE OF GLASSES**  
3 cr. (3 and 0)  
Modern concepts of glass structure and properties.
- CR E 821 ANALYTICAL PROCEDURES AND EQUIPMENT I**  
3 cr. (2 and 3)  
Theory and application of powder X-ray diffractometry, emission spectroscopy, electron microscopy and optical microscopy to ceramic problems.
- CR E 822 ANALYTICAL PROCEDURES AND EQUIPMENT II**  
3 cr. (2 and 3)  
Continuation of CR E 821.
- CR E 824 MECHANICAL PROPERTIES OF CERAMIC MATERIALS**  
3 cr. (3 and 0)  
Stress-strain-time relations in elasticity, plasticity and rupture showing effects of high and low temperature and structures.
- CR E 825 MAGNETIC AND ELECTRICAL CERAMIC MATERIALS**  
3 cr. (3 and 0)  
Application of magnetic and electrical theory to ceramic insulators, semiconductors, and ferroelectric and ferromagnetic products.
- CR E 828 SOLID STATE CERAMIC SCIENCE**  
3 cr. (3 and 0)  
Bonding and structure of crystalline materials as related to mechanical, thermal and chemical properties of solids.
- CR E 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- CR E 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

## Chemical Engineering

Dan D. Edie, Chair, Department of Chemical Engineering

| Major                | Degrees              |
|----------------------|----------------------|
| Chemical Engineering | M.Engr., M.S., Ph.D. |

Students may be accepted with backgrounds in chemistry, physics or branches of engineering other than chemical engineering.

The M.Engr. degree is granted upon completion of an approved program of study which includes 30 credit hours of course work.

Candidates for the M.S. degree must complete a thesis. The M.S. program consists of 30 credit hours of work, including six credit hours of research.

The Ph.D. program consists of 36 credit hours of approved graduate courses beyond the B.S. degree. Doctoral students must satisfy the M.S. course requirements through courses taken either at Clemson University or elsewhere. Each doctoral student is required to complete 30 credit hours of graduate research, including 18 doctoral dissertation research credit hours (CH E 991) taken at Clemson University. These requirements establish **minimum**

course work and research credit requirements and usually are exceeded at the advice of the individual student's advisory committee.

- CH E 601 TRANSPORT PHENOMENA**  
3 cr. (3 and 0)
- CH E 612 POLYMER ENGINEERING**  
3 cr. (3 and 0)
- CH E 624 INTRODUCTION TO INDUSTRIAL POLLUTION**  
3 cr. (3 and 0)
- CH E 628 (AG E 628) BIOCHEMICAL ENGINEERING**  
3 cr. (3 and 0)
- CH E 650 CHEMICAL REACTION ENGINEERING**  
3 cr. (3 and 0)
- CH E 654 COMPUTER PROCESS CONTROL**  
3 cr. (3 and 0)
- CH E 802 PROCESS DYNAMICS AND CONTROL**  
3 cr. (3 and 0)  
Utilization of engineering principles in dynamic analysis and design of chemical processes, processing equipment and plants; systems dynamics; closed loop control and optimization. **Prerequisites:** CH E 353 and MTHSC 208 or permission of instructor.
- CH E 803 ADVANCED TRANSPORT PHENOMENA**  
3 cr. (3 and 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 cr. (3 and 0)  
Equilibria of physical and chemical systems; generalized properties of hydrocarbons; application of thermodynamic methods in equipment design.
- CH E 805 CHEMICAL ENGINEERING KINETICS**  
3 cr. (3 and 0)  
Kinetics of chemical reactions, particularly in design and operation of chemical reactors.
- CH E 814 APPLIED NUMERICAL METHODS IN PROCESS SIMULATION**  
3 cr. (3 and 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 reviewed. **Prerequisite:** Permission of instructor.



- CH E 818 POLYMER PROCESSING**  
3 cr. (3 and 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 cr. (3 and 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. **Prerequisite:** Permission of instructor.
- CH E 820 COMPOSITE POLYMERIC MATERIALS**  
(T C 820) 3 cr. (3 and 0) N  
Morphology, chemistry, processing and physical characterization of engineered fibers and matrix materials; influence of fiber and matrix properties on composite characteristics; application of surface chemistry to analyze fiber/matrix wetting and adhesion. **Prerequisite:** CH 224 or permission of instructor.
- CH E 822 MASS TRANSFER AND DIFFERENTIAL CONTACT OPERATIONS**  
3 cr. (3 and 0)  
Diffusion theory in binary and multicomponent gas and liquid systems; design considerations in absorption and extraction.
- CH E 823 MASS TRANSFER AND STAGewise CONTACT OPERATIONS**  
3 cr. (3 and 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 829 MEMBRANE SEPARATION PROCESSES**  
3 cr. (3 and 0)  
Fundamental principles, mathematical modeling and applications of microfiltration, ultrafiltration, reverse osmosis, gas permeation and pervaporation; introduction to other membrane processes, including dialysis, Donnan dialysis, electrodialysis, liquid membranes, facilitated transport, membrane reactor and controlled release technology. **Prerequisite:** CH E 401 or equivalent or permission of instructor.
- CH E 834 ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS**  
3 cr. (3 and 0)  
Classical and statistical thermodynamics applied to problems in chemical engineering with emphasis on 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 inter-

molecular 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. **Prerequisite:** CH E 804 or equivalent.

- CH E 845 SELECTED TOPICS IN CHEMICAL ENGINEERING**  
3 cr. (3 and 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 cr.  
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. Graded on a pass/fail basis. **Prerequisites:** Permission of instructor and department chair.
- CH E 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- CH E 895 CHEMICAL ENGINEERING GRADUATE SEMINAR**  
1 cr. (1 and 0)  
Series of weekly, one-hour seminars given by students, faculty and guests on topics of current interest. Graded on a pass/fail basis. Credits earned in this course do not apply to nor alter the required minimum of six research hours for the M.S. degree or the required 30 research credit hours for the Ph.D. degree.
- CH E 945 SELECTED TOPICS IN CHEMICAL ENGINEERING**  
3 cr. (3 and 0)  
Primarily a more comprehensive study of topics first covered in CH E 845.
- CH E 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

### Materials Science and Engineering

R. Judd Diefendorf, Program Coordinator, Department of Ceramic Engineering

| Major                             | Degrees     |
|-----------------------------------|-------------|
| Materials Science and Engineering | M.S., Ph.D. |

Students with a baccalaureate degree in any branch of engineering, as well as chemistry, physics and biology majors with a strong mathematical background, may be admitted to the program.

Master's degree candidates must complete 24 credits of course work and six credits of research.

The Doctor of Philosophy degree generally is interdisciplinary in nature. A minimum of 45 credits of course work is required. Qualifying, comprehensive and final examinations are required. No foreign language is required, but proficiency in one is recommended.



|                  |                                                                                                                                                                                                                                                                                                                                                |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>MAT E 663</b> | <b>METALLURGY OF WELDING AND NONDESTRUCTIVE TESTING</b><br>3 cr. (2 and 3)                                                                                                                                                                                                                                                                     |
| <b>MAT E 665</b> | <b>INTRODUCTION TO PLASTICS</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                             |
| <b>MAT E 800</b> | <b>SEMINAR IN MATERIALS RESEARCH</b><br>1 cr. (1 and 0)<br>Presentation and discussion of special topics and original research in materials engineering. Credit may be earned for more than one semester.                                                                                                                                      |
| <b>MAT E 820</b> | <b>DEFORMATION MECHANISMS IN SOLIDS</b><br>3 cr. (3 and 0)<br>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. <b>Prerequisite:</b> Permission of instructor. |
| <b>MAT E 826</b> | <b>PHASE EQUILIBRIA IN MATERIALS SYSTEMS</b><br>3 cr. (3 and 0)<br>Advanced treatment of phase equilibria in materials systems, phase diagrams, thermodynamics of defects, surfaces, interfaces and solutions. <b>Prerequisites:</b> CR E 310 and permission of instructor. <b>Corequisite:</b> M E 810.                                       |
| <b>MAT E 827</b> | <b>KINETICS OF PHASE TRANSFORMATION</b><br>3 cr. (3 and 0)<br>Advanced treatment of the kinetics of phase transformation in materials systems, including nucleation, growth and spinodal decomposition. <b>Prerequisites:</b> MAT E 826 or equivalent, graduate standing and permission of instructor.                                         |
| <b>MAT E 991</b> | <b>DOCTORAL DISSERTATION RESEARCH</b><br>Credit to be arranged.                                                                                                                                                                                                                                                                                |

*The following courses offered by various departments complete the curriculum for the program. Descriptions for all 800-level courses are under the respective departmental headings.*

|                  |                                                                           |
|------------------|---------------------------------------------------------------------------|
| <b>BIO E 801</b> | <b>BIOMATERIALS</b><br>3 cr. (3 and 0)                                    |
| <b>BIO E 803</b> | <b>POLYMERIC BIOMATERIALS</b><br>3 cr. (3 and 0)                          |
| <b>BIO E 805</b> | <b>COMPOSITE BIOMATERIALS</b><br>3 cr. (3 and 0)                          |
| <b>BIO E 850</b> | <b>SPECIAL TOPICS IN BIOMEDICAL ENGINEERING</b><br>1-4 cr. (0-4 and 12-0) |
| <b>CR E 807</b>  | <b>SPECIALIZED CERAMICS</b><br>3 cr. (3 and 0)                            |
| <b>CR E 809</b>  | <b>HIGH-TEMPERATURE MATERIALS</b><br>3 cr. (3 and 0)                      |
| <b>CR E 814</b>  | <b>CERAMIC PHYSICAL PROCESSING</b><br>3 cr. (3 and 0)                     |
| <b>CR E 815</b>  | <b>COLLOIDAL AND SURFACE SCIENCE</b><br>3 cr. (3 and 0)                   |

|                               |                                                                                                 |
|-------------------------------|-------------------------------------------------------------------------------------------------|
| <b>CR E 816</b>               | <b>CONSTITUTION AND STRUCTURE OF GLASSES</b><br>3 cr. (3 and 0)                                 |
| <b>CR E 821</b>               | <b>ANALYTICAL PROCEDURES AND EQUIPMENT I</b><br>3 cr. (2 and 3)                                 |
| <b>CR E 822</b>               | <b>ANALYTICAL PROCEDURES AND EQUIPMENT II</b><br>3 cr. (2 and 3)                                |
| <b>CR E 824</b>               | <b>MECHANICAL PROPERTIES OF CERAMIC MATERIALS</b><br>3 cr. (3 and 0)                            |
| <b>CR E 825</b>               | <b>MAGNETIC AND ELECTRICAL CERAMIC MATERIALS</b><br>3 cr. (3 and 0)                             |
| <b>CR E 828</b>               | <b>SOLID STATE CERAMIC SCIENCE</b><br>3 cr. (3 and 0)                                           |
| <b>CH E 601</b>               | <b>TRANSPORT PHENOMENA</b><br>3 cr. (3 and 0)                                                   |
| <b>CH E 612</b>               | <b>POLYMER ENGINEERING</b><br>3 cr. (3 and 0)                                                   |
| <b>CH E 803</b>               | <b>ADVANCED TRANSPORT PHENOMENA</b><br>3 cr. (3 and 0)                                          |
| <b>CH E 818</b>               | <b>POLYMER PROCESSING</b><br>3 cr. (3 and 0)                                                    |
| <b>CH E 819</b>               | <b>VISCOELASTIC PROPERTIES OF POLYMERS AND POLYMERIC COMPOSITES</b><br>3 cr. (3 and 0)          |
| <b>CH E 820<br/>(T C 820)</b> | <b>COMPOSITE POLYMERIC MATERIALS</b><br>3 cr. (3 and 0) N                                       |
| <b>CH 602</b>                 | <b>INORGANIC CHEMISTRY</b><br>3 cr. (3 and 0) F                                                 |
| <b>CH 804</b>                 | <b>FUNDAMENTAL PRINCIPLES OF INORGANIC CHEMISTRY</b><br>3 cr. (3 and 0) F                       |
| <b>CH 809</b>                 | <b>CHEMICAL APPLICATIONS OF X-RAY CRYSTALLOGRAPHY</b><br>3 cr. (2 and 2) S (odd numbered years) |
| <b>CH 811</b>                 | <b>ANALYTICAL CHEMISTRY</b><br>3 cr. (3 and 0) F                                                |
| <b>CH 812</b>                 | <b>CHEMICAL SPECTROSCOPIC METHODS</b><br>3 cr. (2 and 3) S                                      |
| <b>CH 910</b>                 | <b>SELECTED TOPICS IN ANALYTICAL CHEMISTRY</b><br>1-4 cr. (1-4 and 0) N                         |
| <b>E M 630</b>                | <b>MECHANICS OF COMPOSITE MATERIAL</b><br>3 cr. (3 and 0)                                       |
| <b>E M 831</b>                | <b>THEORY OF ELASTICITY I</b><br>3 cr. (3 and 0)                                                |



|                                     |                                                                             |
|-------------------------------------|-----------------------------------------------------------------------------|
| <b>E M 832</b>                      | <b>THEORY OF ELASTICITY II</b><br>3 cr. (3 and 0)                           |
| <b>E M 836</b>                      | <b>FRACTURE MECHANICS</b><br>3 cr. (3 and 0)                                |
| <b>E M 852</b><br><b>(C E 852)</b>  | <b>ADVANCED FINITE ELEMENT ANALYSIS</b><br>3 cr. (3 and 0)                  |
| <b>M E 801</b>                      | <b>FOUNDATIONS OF FLUID MECHANICS</b><br>3 cr. (3 and 0)                    |
| <b>M E 810</b>                      | <b>MACROSCOPIC THERMODYNAMICS</b><br>3 cr. (3 and 0)                        |
| <b>M E 815</b><br><b>(PHYS 815)</b> | <b>STATISTICAL THERMODYNAMICS I</b><br>3 cr. (3 and 0)                      |
| <b>M E 818</b>                      | <b>INTRODUCTION TO FINITE ELEMENT ANALYSIS</b><br>3 cr. (3 and 0)           |
| <b>M E 932</b>                      | <b>ADVANCED TOPICS IN THERMODYNAMICS</b><br>3 cr. (3 and 0)                 |
| <b>PHYS 811</b>                     | <b>METHODS OF THEORETICAL PHYSICS I</b><br>3 cr. (3 and 0)                  |
| <b>PHYS 812</b>                     | <b>METHODS OF THEORETICAL PHYSICS II</b><br>3 cr. (3 and 0)                 |
| <b>PHYS 816</b>                     | <b>STATISTICAL THERMODYNAMICS II</b><br>3 cr. (3 and 0)                     |
| <b>PHYS 845</b>                     | <b>SOLID STATE PHYSICS I</b><br>3 cr. (3 and 0)                             |
| <b>PHYS 846</b>                     | <b>SOLID STATE PHYSICS II</b><br>3 cr. (3 and 0)                            |
| <b>T C 615</b>                      | <b>INTRODUCTION TO POLYMER SCIENCE AND ENGINEERING</b><br>3 cr. (3 and 0) F |
| <b>T C 811</b>                      | <b>POLYMER SCIENCE I</b><br>3 cr. (3 and 0) F                               |
| <b>T C 812</b>                      | <b>POLYMER SCIENCE II</b><br>3 cr. (3 and 0) S                              |
| <b>TEXT 821</b>                     | <b>FIBER PHYSICS I</b><br>3 cr. (3 and 0) F                                 |
| <b>TEXT 822</b>                     | <b>FIBER PHYSICS II</b><br>3 cr. (3 and 0) S                                |
| <b>TEXT 830</b>                     | <b>TEXTILE PHYSICS</b><br>3 cr. (3 and 0) F                                 |
| <b>TEXT 835</b>                     | <b>TEXTILE STRUCTURES I</b><br>3 cr. (3 and 0) F                            |
| <b>TEXT 846</b>                     | <b>TEXTILE STRUCTURES II</b><br>3 cr. (3 and 0) S                           |
| <b>TEXT 866</b>                     | <b>FIBER FORMATION</b><br>3 cr. (3 and 0) S                                 |

**School of Environmental Engineering and Science**

Glen T. Daigger, Director

Environmental Science and Policy  
Environmental Systems Engineering  
Environmental Toxicology  
Hydrogeology

**Environmental Science and Policy**

Alan W. Elzerman, Program Director, Department of Environmental Systems Engineering

Advanced degrees are not awarded in environmental science, but courses are offered to provide a minor, a concentration or electives for students in other areas. Course selection for a minor or concentration should be approved in advance.

|                  |                                                                |
|------------------|----------------------------------------------------------------|
| <b>EN SP 631</b> | <b>PUBLIC HEALTH ADMINISTRATION</b><br>3 cr. (3 and 0) N       |
| <b>EN SP 671</b> | <b>MAN AND HIS ENVIRONMENT</b><br>2 cr. (2 and 0) N            |
| <b>EN SP 672</b> | <b>ENVIRONMENTAL PLANNING AND CONTROL</b><br>2 cr. (2 and 0) N |

**Environmental Systems Engineering**

Glen T. Daigger, Chair, Department of Environmental Systems Engineering

| <b>Major</b>                         | <b>Degrees</b>       |
|--------------------------------------|----------------------|
| Environmental<br>Systems Engineering | M.Engr., M.S., Ph.D. |

Students with a baccalaureate degree in any branch of engineering, as well as chemistry, physics, geology and biology majors with a strong mathematical background, may be admitted to the program.

Research master's degree candidates must complete 24 hours of course work and six hours of research culminating in the presentation of a satisfactory thesis for M.S. candidates or a special problem report for M.Engr. candidates. An M.S. nonthesis option which requires 33 hours of course work is available.

The Ph.D. program generally is interdisciplinary in nature. Each student's research program is tailored to suit his or her personal and professional goals. Qualifying, comprehensive and final examinations are required. No foreign language is required.

|                                                             |                                                                          |
|-------------------------------------------------------------|--------------------------------------------------------------------------|
| <b>E S E 601</b>                                            | <b>ENVIRONMENTAL ENGINEERING</b><br>3 cr. (3 and 0) F, S                 |
| <b>E S E 602</b>                                            | <b>WATER AND WASTE TREATMENT SYSTEMS</b><br>3 cr. (3 and 0) S            |
| <b>E S E 608</b><br><b>(AG E 608)</b><br><b>(AGRON 608)</b> | <b>LAND TREATMENT OF WASTEWATER AND SLUDGES</b><br>3 cr. (3 and 0) F     |
| <b>E S E 610</b>                                            | <b>ENVIRONMENTAL RADIATION PROTECTION</b><br>3 cr. (3 and 0) F           |
| <b>E S E 611</b>                                            | <b>IONIZING RADIATION DETECTION AND MEASUREMENT</b><br>2 cr. (1 and 3) S |
| <b>E S E 630</b>                                            | <b>AIR POLLUTION ENGINEERING</b><br>3 cr. (3 and 0) S                    |



- E S E 651**  
(AG E 651)  
(FOR 651) **NEWMAN SEMINAR AND LECTURE SERIES IN NATURAL RESOURCES ENGINEERING**  
1 cr. (0 and 2) S, F
- E S E 682**  
(C E 682) **GROUNDWATER AND CONTAMINANT TRANSPORT**  
3 cr. (3 and 0) S
- E S E 684**  
(AG E 684)  
(I E 684) **MUNICIPAL SOLID WASTE MANAGEMENT**  
3 cr. (3 and 0) S
- E S E 685** **HAZARDOUS WASTE MANAGEMENT**  
3 cr. (3 and 0) S
- E S E 701** **SPECIAL PROBLEMS**  
1-6 cr. (1-6 and 0) F, S  
Environmental engineering problems selected to meet the interests and experience of student and instructor; formal report required. Restricted to Master of Engineering students. Graded on a pass/fail basis.
- E S E 802** **ENVIRONMENTAL ENGINEERING PRINCIPLES**  
3 cr. (3 and 0) F  
Fundamental principles required for simulation and modeling of environmental engineering phenomena. Topics include mass transfer, reactor kinetics, simulation techniques and applications to various natural and engineered systems.
- E S E 803** **PHYSICOCHEMICAL OPERATIONS IN WATER AND WASTEWATER TREATMENT SYSTEMS**  
4 cr. (4 and 0) S  
Principles of physicochemical operations used in water and wastewater treatment, including sedimentation, filtration, mixing, gas transfer, adsorption, ion exchange, coagulation, precipitation, disinfection and oxidation. **Prerequisites:** E S E 802 and 843.
- E S E 804** **BIOCHEMICAL OPERATIONS IN WASTEWATER TREATMENT SYSTEMS**  
3 cr. (3 and 0) S  
Principles of biochemical operations used in wastewater treatment; includes modeling of ideal biochemical reactors and design criteria for aerated lagoons, activated sludge, trickling filters, rotating biological contactors, nitrification, denitrification and digestion. **Prerequisites:** E S E 802 and either E S E 851 or permission of instructor.
- E S E 805** **LABORATORY IN WATER AND WASTEWATER TREATMENT OPERATIONS**  
2 cr. (0 and 6) S  
Laboratory exercises in selected water and wastewater treatment operations, including sedimentation, filtration, adsorption, coagulation, softening, aeration, activated sludge, aerobic digestion and anaerobic digestion. **Corequisites:** E S E 803 and 804.
- E S E 806** **INTEGRATED DESIGN OF WATER AND WASTEWATER TREATMENT SYSTEMS**  
4 cr. (4 and 0) F  
Integration of unit operations into complex systems for treatment of industrial/domestic water

and wastewater, contaminated groundwater, landfill leachate and toxic liquid wastes; the team approach is employed in the design of one integrated system for either water/wastewater or a hazardous/toxic waste. **Prerequisites:** E S E 803 and 804.

- E S E 809** **INDUSTRIAL WASTEWATER TREATMENT**  
3 cr. (3 and 0) N  
Industrial wastewater management and the application of liquid treatment processes to the solution of specific industrial wastewater problems; case studies of industrial wastewater treatment strategies. **Prerequisites:** E S E 803 and 804.
- E S E 812** **ENVIRONMENTAL NUCLEAR ENGINEERING**  
3 cr. (3 and 0) S  
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. **Prerequisites:** E S E 610 and permission of instructor.
- E S E 813** **ENVIRONMENTAL RADIATION PROTECTION LABORATORY**  
1 cr. (0 and 3) F  
Continuation of E S E 611; advanced experiments in radiation detection, radiation protection, health physics and environmental monitoring. **Prerequisites:** E S E 611 and permission of instructor.
- E S E 832** **AIR POLLUTION METEOROLOGY**  
3 cr. (3 and 0) F  
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. **Prerequisite:** Permission of instructor.
- E S E 833** **AIR POLLUTION CONTROL SYSTEMS**  
3 cr. (3 and 0) F  
Principles and design of air pollution control equipment including mechanical collectors, electrostatic precipitators, baghouse filters, wet scrubbers, adsorbers and incinerators. **Prerequisite:** E S E 430/630 or permission of instructor.
- E S E 843** **ENVIRONMENTAL ENGINEERING CHEMISTRY I**  
3 cr. (3 and 0) F  
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. **Prerequisites:** CH 101 and 102 or equivalent.



- E S E 844 ENVIRONMENTAL ENGINEERING CHEMISTRY LABORATORY I**  
3 cr. (2 and 1) F  
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. **Prerequisite:** Two semesters of general chemistry.
- E S E 845 ENVIRONMENTAL ENGINEERING CHEMISTRY II**  
3 cr. (3 and 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. **Prerequisites:** Two semesters of general chemistry and ESE 843 or equivalent.
- E S E 847 ADVANCED TOPICS IN ENVIRONMENTAL ENGINEERING CHEMISTRY**  
3 cr. (3 and 0) S  
Advanced principles and methods in environmental engineering chemistry with applications to both natural and treatment systems; current investigative and study techniques. Topics include the nature, fluxes and controlling processes of chemical species and radionuclides in environmental systems. **Prerequisite:** E S E 843 or equivalent.
- E S E 849 ENVIRONMENTAL ENGINEERING CHEMISTRY LABORATORY II**  
2 cr. (0 and 6) N  
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.
- E S E 850 STREAM AND ESTUARINE ANALYSIS**  
3 cr. (3 and 0) F  
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.
- E S E 851 BIOLOGICAL PRINCIPLES OF ENVIRONMENTAL ENGINEERING**  
3 cr. (3 and 0) F  
Basic principles of biology and biochemistry as applied to problems of environmental control and wastewater treatment; kinetic and energetic aspects are emphasized.
- E S E 856 POLLUTION OF THE AQUATIC ENVIRONMENT**  
3 cr. (3 and 0) S  
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.
- E S E 857 POLLUTION OF THE AQUATIC ENVIRONMENT LABORATORY**  
1 cr. (0 and 3) N  
Field and laboratory investigations into physical, chemical and biological effects resulting from pollution of the aquatic environment.
- E S E 861 ENVIRONMENTAL SYSTEMS ENGINEERING SEMINAR**  
1 cr. (1 and 0) F, S  
Current advances and research developments in various areas of environmental engineering; off-campus speakers, students and faculty participate. Graded on a pass/fail basis.
- E S E 862 ENVIRONMENTAL QUALITY CASE STUDY**  
1 cr. (0 and 3) N  
Analysis and investigation of a significant current or recent situation affecting or involving some facet of environmental quality. Study is conducted by a team of students and results in a comprehensive position paper which integrates the pertinent social, political and economic considerations in the case with the technical aspects.
- E S E 880 ENVIRONMENTAL RISK ASSESSMENT**  
3 cr. (3 and 0) S  
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. **Prerequisites:** MTHSC 208 and graduate-level standing in engineering or science.
- E S E 881 SPECIAL PROBLEMS**  
1-4 cr. F, S  
Problems selected to meet interests and experience of student and instructor.
- E S E 883 SELECTED TOPICS IN ENVIRONMENTAL ENGINEERING**  
1-4 cr. F, S  
A topic in environmental engineering not covered in another course. Topic varies to keep pace with current developments. May be taken concurrently with E S E 884, which (if offered) would be a different topic.
- E S E 884 SELECTED TOPICS IN ENVIRONMENTAL ENGINEERING**  
1-4 cr. F, S  
A topic in environmental engineering not covered in another course. Topic varies to keep pace with current developments. May be taken concurrently with E S E 883, which (if offered) would be a different topic.



**E S E 891 MASTER'S THESIS RESEARCH**

Credit to be arranged. F, S

**E S E 991 DOCTORAL DISSERTATION RESEARCH**

Credit to be arranged. F, S

**Environmental Toxicology**

Ronald J. Kendall, Chair, Department of Environmental Toxicology

**Major**  
Environmental  
Toxicology

**Degrees**  
M.S., Ph.D.

See the College of Agriculture, Forestry and Life Sciences for information on this program.

**Hydrogeology**

Richard D. Warner, Chair, Department of Earth Sciences

**Major**  
Hydrogeology

**Degree**  
M.S.

Candidates for the Master of Science degree in hydrogeology should have a baccalaureate degree in the geosciences. However, students having a strong undergraduate background in chemistry, physics or biology, or in civil, environmental or agricultural engineering may be admitted but will be required to correct deficiencies in their geologic education during the first year.

Two options are offered for the M.S. degree. The nonthesis option requires 30 semester hours of course work and a final written examination. The thesis option requires 24 semester hours of course work and 6 hours of thesis research. Candidates must write a thesis based on original research and defend it at an oral examination.

All candidates must take at least six core courses; three of these must be 800-level geology courses. Students may also select a number of recommended elective courses in engineering and geology from an approved list available in the department.

**GEOL 600 ENVIRONMENTAL GEOLOGY**  
3 cr. (3 and 0)

**GEOL 601 APPLIED GEOPHYSICS**  
3 cr. (2 and 2)

**GEOL 603 INVERTEBRATE PALEONTOLOGY**  
3 cr. (2 and 3)

**GEOL 604 ECONOMIC GEOLOGY**  
3 cr. (3 and 0)

**GEOL 605 GEOMORPHOLOGY**  
3 cr. (2 and 2)

**GEOL 607 QUATERNARY GEOLOGY**  
3 cr. (2 and 2)

**GEOL 608 GEOHYDROLOGY**  
3 cr. (3 and 0)

**GEOL 612 GEOCHEMICAL ANALYTICAL TECHNIQUES**  
3 cr. (1 and 4)

**GEOL 613 STRATIGRAPHY**  
3 cr. (2 and 2)

**GEOL 651 SELECTED TOPICS IN HYDROGEOLOGY**  
1-4 cr. (1-3 and 0-3)

**GEOL 700****GEOLOGY FOR SCIENCE TEACHERS**

3 cr. (2 and 3)

Geology for elementary and secondary school teachers of earth science and physical sciences; geologic methods; origin of the earth, rocks and minerals; processes and changes through time of the crust and surface; field trips provide practical examples.

**GEOL 740****EARTH/SPACE SCIENCE FOR ELEMENTARY SCHOOL TEACHERS**

3 cr. (2 and 3)

Comprehension and application of earth/space science concepts suitable for classroom use at the elementary school level; earth science concepts will be related to South Carolina geological features.

**GEOL 790****SELECTED TOPICS IN EARTH SCIENCES**

1-6 cr. (0-6 and 0-18)

A study of 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 cr. (2 and 3)

Lectures and project-oriented field work focusing on processes controlling natural impurities in groundwater and the occurrence of inorganic, organic and radioactive contaminants. Topics include solution equilibria, chemical weathering, oxidation-reduction, utilization of radioactive isotopes as tracers and studies of contamination plumes. **Prerequisites:** CH 101 and 102 or equivalent.

**GEOL 801****GROUNDWATER GEOPHYSICAL TECHNIQUES**

3 cr. (1 and 4)

Lectures and project-oriented field work focusing on the utilization of geophysical instruments to detect groundwater-bearing fracture zones, to determine the depth to the water table, and to map contamination plumes. **Prerequisite:** PHYS 221 or permission of instructor.

**GEOL 804****WATER WELL EXPLORATION, DRILLING AND MONITORING**

3 cr. (2 and 2)

Locating sites for high yield water wells by means of satellite imagery, aerial photographs, topographic maps, subsurface and surface geological maps; drilling and coring techniques; installation of monitor wells and interpretation of data from monitor wells. **Prerequisite:** GEOL 408/608 or its equivalent.

**GEOL 805****ADVANCED STRATIGRAPHY**

3 cr. (3 and 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. **Prerequisite:** GEOL 413/613 or permission of instructor.



- GEOL 808 GROUNDWATER MODELING**  
4 cr. (3 and 2)  
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. **Prerequisite:** Permission of instructor.
- GEOL 809 SUBSURFACE REMEDIATION MODELING**  
3 cr. (3 and 0)  
Lectures and computer exercises involving subsurface remediation methods, including groundwater extraction, soil vapor extraction, steam flooding and a variety of other techniques; emphasis is on modeling flow of multiphase and multicomponent mixtures in porous medium. **Prerequisite:** GEOL 808 or permission of instructor.
- GEOL 810 ANALYTICAL METHODS FOR HYDROGEOLOGY**  
3 cr. (3 and 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. **Prerequisite:** GEOL 808 or a graduate level groundwater course or permission of instructor.
- GEOL 850 SELECTED TOPICS IN ENVIRONMENTAL GEOLOGY**  
1-4 cr. (1-3 and 0-3)  
Selected topics in environmental geology emphasizing the subsurface contamination. May be repeated for a maximum of six credit hours, but only if different topics are covered. **Prerequisite:** Permission of instructor.
- GEOL 851 GEOLOGY SEMINAR**  
1 cr. (1 and 0)  
Students review current topics in geology and make oral presentations. May be taken twice for credit.
- GEOL 875 HYDROGEOLOGY SUMMER FIELD CAMP**  
6 cr. (4 and 6)  
Groundwater geology field techniques including examination of surface exposures, analysis of cores and geophysical well logs, subsurface mapping, aquifer performance tests and groundwater remediation. **Prerequisite:** Permission of instructor.
- GEOL 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.

### *School of Mechanical and Industrial Engineering*

James A. Liburdy, Director

Engineering Graphics  
Engineering Mechanics  
Industrial Engineering  
Mechanical Engineering

### **Engineering Graphics**

William F. Beckwith, Program Director, Freshman Engineering and Engineering Graphics

Advanced degrees are not awarded in engineering graphics. Courses are offered as electives for students in engineering and other areas.

- E G 612 INTERACTIVE COMPUTER GRAPHICS**  
3 cr. (3 and 0)
- E G 690 SPECIAL TOPICS IN ENGINEERING AND COMPUTER GRAPHICS**  
1-3 cr.
- E G 823 COMPUTER-AIDED GEOMETRIC MODELING**  
3 cr. (3 and 0)  
Shape modeling and design by computer; curve and surface representation, methods of solid modeling by computer; data base representation and integral properties of solid models. **Prerequisite:** Graduate standing.

### **Engineering Mechanics**

Eugene H. Bishop, Chair, Department of Mechanical Engineering

| Major                 | Degrees     |
|-----------------------|-------------|
| Engineering Mechanics | M.S., Ph.D. |

Enrollment is open to students with baccalaureate or master's degrees in any branch of engineering and to those with degrees in physics or applied mathematics who have credit for certain prescribed courses in engineering.

Candidates for the M.S. degree are required to write a thesis and complete 30 hours of course work, including six hours of thesis research. Candidates for the Ph.D. degree are required to complete 18 hours of dissertation research.

- E M 625 ADVANCED STRENGTH OF MATERIALS**  
3 cr. (3 and 0)
- E M 630 MECHANICS OF COMPOSITE MATERIALS**  
3 cr. (3 and 0)
- E M 650 MECHANICAL VIBRATIONS**  
3 cr. (3 and 0)
- E M 829 ENERGY METHODS AND VARIATIONAL PRINCIPLES**  
3 cr. (3 and 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. **Prerequisite:** E M 831 or permission of instructor.
- E M 831 THEORY OF ELASTICITY I**  
3 cr. (3 and 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. **Prerequisites:** E M 304 and MTHSC 208.



- E M 832**      **THEORY OF ELASTICITY II**  
3 cr. (3 and 0)  
Continuation of E M 831, 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. **Prerequisites:** E M 831 and PHYS 812.
- E M 834**      **PRINCIPLES OF STRUCTURAL STABILITY**  
3 cr. (3 and 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. **Prerequisite:** E M 831.
- E M 836**      **FRACTURE MECHANICS**  
3 cr. (3 and 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. **Prerequisite:** E M 831.
- E M 845**      **INTERMEDIATE DYNAMICS**  
3 cr. (3 and 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. **Prerequisite:** E M 202 or permission of instructor.
- E M 852**  
(C E 852)      **ADVANCED FINITE ELEMENT ANALYSIS**  
3 cr. (3 and 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. **Prerequisite:** C E 808 or equivalent, or permission of instructor.
- E M 891**      **MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- E M 893**      **SELECTED TOPICS IN ENGINEERING MECHANICS**  
1-6 cr. (1-6 and 0)  
Topics not covered in other courses. May be repeated for credit.
- E M 901**      **FOUNDATIONS OF NONLINEAR SHELL THEORY**  
3 cr. (3 and 0)  
Development of classical linear and nonlinear foundations used to analyze thin shells of arbitrary geometric shape; general equations are specialized for thin shells made from isotropic and orthotropic materials and nonhomogeneous

shells such as sandwich and fiber-reinforced composite shells. **Prerequisites:** E M 829 and 831.

- E M 991**      **DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

### Industrial Engineering

Michael Steven Leonard, Chair, Department of Industrial Engineering

| Major                  | Degrees     |
|------------------------|-------------|
| Industrial Engineering | M.S., Ph.D. |

Students with a bachelor's degree in engineering or the physical sciences may be accepted. Those with other backgrounds may be accepted or may be required to complete successfully certain prerequisite courses before acceptance into the program.

Students may pursue an M.S. degree with a thesis, requiring a minimum of 24 graduate credit hours of course work, six credit hours of master's thesis research and one credit hour of seminar. Alternatively, students may pursue an M.S. degree without a thesis, requiring a minimum of 30 graduate credit hours of course work, three credit hours of project work and one credit hour of seminar. The prescribed credit hours of course work are agreed upon by the student and his or her advisory committee.

The Ph.D. degree has a minimum requirement of 48 semester credit hours of graduate course work. A dissertation is mandatory for all Ph.D. candidates and requires 18 credit hours of doctoral research.

- I E 601**      **WORK METHODS AND MEASUREMENT II**  
3 cr. (2 and 3)
- I E 622**      **EXPERT SYSTEMS**  
3 cr. (3 and 0)
- I E 652**      **RELIABILITY ENGINEERING**  
3 cr. (3 and 0)
- I E 660**      **QUALITY IMPROVEMENT METHODS**  
3 cr. (3 and 0)
- I E 661**      **QUALITY ENGINEERING**  
3 cr. (3 and 0)
- I E 665**      **FACILITIES PLANNING AND DESIGN**  
3 cr. (3 and 0)
- I E 673**      **MICROCOMPUTER APPLICATIONS IN INDUSTRIAL ENGINEERING**  
3 cr. (2 and 3)
- I E 682**      **SYSTEMS MODELING**  
3 cr. (3 and 0)
- I E 683**      **CASE STUDIES IN INDUSTRIAL ENGINEERING**  
3 cr. (3 and 0)
- I E 684**  
(AG E 684)  
(E S E 684)      **MUNICIPAL SOLID WASTE MANAGEMENT**  
3 cr. (3 and 0) S
- I E 685**      **INDUSTRIAL SYSTEMS ENGINEERING**  
3 cr. (3 and 0)
- I E 686**      **PRODUCTION PLANNING AND CONTROL**  
3 cr. (3 and 0)\*
- I E 687**      **INDUSTRIAL SAFETY**  
3 cr. (3 and 0)



- I E 688 HUMAN FACTORS ENGINEERING**  
3 cr. (3 and 0)
- I E 689 INDUSTRIAL ERGONOMICS**  
3 cr. (2 and 3)
- I E 691 SELECTED TOPICS IN INDUSTRIAL ENGINEERING**  
1-3 cr. (0-3 and 0-9)
- I E 692 DESIGN TOPICS IN INDUSTRIAL ENGINEERING**  
1-3 cr. (1-3 and 0)
- I E 801 DESIGN AND ANALYSIS OF HUMAN-MACHINE SYSTEMS**  
3 cr. (3 and 0)  
Methodologies used in the design and evaluation of human-machine systems, including function and task analysis; questionnaires and interviews; scenarios, mockups 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. **Prerequisites:** Graduate standing and permission of instructor.
- I E 802 DESIGN OF HUMAN-COMPUTER SYSTEMS**  
3 cr. (3 and 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. **Prerequisite:** I E 801 or permission of instructor.
- I E 803 ENGINEERING OPTIMIZATION AND APPLICATIONS**  
3 cr. (3 and 0)  
Introduction to optimization through the study of problems related to the planning, design and control of production/manufacturing systems. Topics include classical nonlinear optimization and algorithmic procedures, primal and dual problems with postoptimality analysis, Markov chains and selected topics. **Prerequisites:** Graduate standing and permission of instructor.
- I E 804 MANUFACTURING SYSTEMS PLANNING AND DESIGN**  
3 cr. (3 and 0)  
Concepts and principles associated with the design of manufacturing systems with a focus on modeling and integration methodologies. Topics include group technology, process planning, manufacturing modeling and design for manufacturing. **Prerequisites:** Graduate standing and permission of instructor.
- I E 805 FOUNDATIONS IN QUALITY ENGINEERING**  
3 cr. (3 and 0)  
Fundamental tools of quality engineering and their application to real situations. Topics include advanced statistical process control, design of experiments, Taguchi techniques and Shainin methodologies. **Prerequisites:** Graduate standing and permission of instructor.
- I E 807 DISCRETE SYSTEMS SIMULATION**  
3 cr. (3 and 0)  
Discrete and Monte Carlo simulation used to model and study stochastic operational systems; simulation languages GPSS V, SLAM and/or SIMAN. **Prerequisite:** Introductory statistics or permission of instructor.
- I E 808 CONTINUOUS SYSTEMS SIMULATION**  
3 cr. (3 and 0)  
Continuous systems simulation including systems with feedback and analysis of such systems, emphasizing industrial and management applications. **Prerequisite:** I E 807.
- I E 811 HUMAN FACTORS IN QUALITY CONTROL**  
3 cr. (3 and 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. **Prerequisites:** Graduate standing and permission of instructor.
- I E 860 DYNAMIC PROGRAMMING**  
3 cr. (3 and 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; emphasis is on special aspects of problem formulation. **Prerequisite:** I E 803.
- I E 861 NONLINEAR PROGRAMMING**  
3 cr. (3 and 0)  
Methods for nonlinear, continuous problems; classical optimization; separable programming; quadratic programming; geometric programming; gradient methods; feasible directions; accelerating adaptive direct search methods. **Prerequisite:** I E 803.
- I E 865 FACILITY PLANNING AND DESIGN**  
3 cr. (3 and 0)  
Planning and design of industrial facilities emphasizing automated production facilities; quantitative approaches to equipment design and evaluation of performance. **Prerequisite:** I E 803.
- I E 871 INDUSTRIAL TESTING AND QUALITY**  
3 cr. (3 and 0)  
Design and use of component and product tests; automated inspection; test and inspection in integrated systems; cost-based models. **Prerequisite:** I E 661.
- I E 872 DESIGN FOR QUALITY**  
3 cr. (3 and 0)  
Advanced quality engineering techniques with application to design of products and processes. Topics include advanced statistical techniques as well as contemporary modifications such as Taguchi and Shainin methodologies. **Prerequisites:** I E 805 and EX ST 805.



- I E 873 COMPUTER-AIDED MANUFACTURING**  
3 cr. (2 and 3)  
Principles associated with automated manufacturing systems, emphasizing computer control and real time concepts. Topics include NC, GT, PLC, robotics, process planning, real time control and networking. **Prerequisites:** Graduate standing and permission of instructor.
- I E 880 ADVANCED METHODS OF OPERATIONS RESEARCH**  
3 cr. (3 and 0)  
Methods and applications of advanced operations research techniques. Topics may include discrete optimization, integer and mixed integer programming, Boolean minimization, network optimization, permutization methods on implicit enumeration. **Prerequisite:** I E 803 or permission of instructor.
- I E 884 ADVANCED ENGINEERING ECONOMIC ANALYSIS**  
3 cr. (3 and 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.). **Prerequisite:** Permission of instructor.
- I E 885 DESIGN AND ANALYSIS OF SIMULATION MODELS**  
3 cr. (3 and 0)  
Design and validation of operations research-type simulation models; statistical analysis of input and output data of these models. **Prerequisites:** I E 807 and MA SC 814 or permission of instructor.
- I E 886 OPERATIONS RESEARCH IN PRODUCTION CONTROL**  
3 cr. (3 and 0)  
Latest techniques in scientific inventory management, scheduling and forecasting; operations research; statistics; computer methods; case studies. **Prerequisite:** I E 803.
- I E 888 APPLIED QUEUEING THEORY AND MARKOV PROCESSES**  
3 cr. (3 and 0)  
Advanced treatment of stochastic optimization, potentially including single and multiple channel queues, Markov programming and stochastic optimal control. **Prerequisite:** I E 860 or permission of instructor.
- I E 890 SPECIAL PROBLEMS IN INDUSTRIAL ENGINEERING**  
1-3 cr. (1-3 and 0)  
Principles and methods of industrial engineering applied to analysis of a current interest problem. May be repeated for additional credit. Graded on a pass/fail basis. **Prerequisite:** Permission of instructor.
- I E 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- I E 892 MASTER'S DESIGN PROJECT**  
3 cr. (1 and 6)  
Design project in industrial systems; integration of IE principles and methodologies; resolution of contemporary systems design problems; project requires research, development, implementation planning, reporting and project assessment. **Prerequisite:** Permission of instructor.
- I E 893 SELECTED TOPICS IN INDUSTRIAL ENGINEERING**  
1-3 cr. (1-3 and 0)  
Selected topics in industrial engineering emphasizing new developments in systems science, systems analysis and operations research. May be repeated for additional credit. **Prerequisite:** Permission of instructor.
- I E 895 INDUSTRIAL ENGINEERING RESEARCH TECHNIQUES**  
1 cr. (1 and 0)  
Series of weekly, one-hour lectures given by students, faculty and guests on methods and issues involved in industrial engineering research. Graded on a pass/fail basis.
- I E 907 PRODUCTION SYSTEMS SIMULATION**  
3 cr. (2 and 3)  
Simulation modeling of production systems with emphasis on significant design and control issues in automated manufacturing. **Prerequisite:** I E 807.
- I E 971 ADVANCED QUALITY ENGINEERING SEMINAR**  
3 cr. (3 and 0)  
Current topics in the research and development of quality engineering methodologies. **Prerequisite:** I E 871 or permission of instructor.
- I E 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

### Mechanical Engineering

Eugene H. Bishop, Chair, Department of Mechanical Engineering

**Major**  
Mechanical  
Engineering

**Degrees**  
M.Engr., M.S., Ph.D.

Students are accepted for the Master of Engineering degree program with undergraduate degrees in mechanical engineering or equivalent. Enrollment in the M.S. and Ph.D. programs is open to those students with degrees in physics, applied mathematics or any branch of engineering.

Students in the M.S. degree program may choose the thesis or nonthesis option. Students in the thesis program must complete 30 hours of course work, including six hours of thesis research. Students in the nonthesis program and in the M.Engr. program must complete 33 hours of course work, including six hours of project-related credits. Students in the Ph.D. program must complete 18 hours of dissertation research.

**M E 607 APPLIED HEAT TRANSFER**  
3 cr. (3 and 0)

**M E 617 CONTROL SYSTEMS DESIGN**  
3 cr. (2 and 1)



- M E 620 ENERGY SOURCES AND THEIR UTILIZATION**  
3 cr. (3 and 0)
- M E 621 INTRODUCTION TO COMPRESSIBLE FLOW**  
3 cr. (3 and 0)
- M E 622 DESIGN OF GAS TURBINES**  
3 cr. (3 and 0)
- M E 623 INTRODUCTION TO AERODYNAMICS**  
3 cr. (3 and 0)
- M E 625 KINEMATICS AND DYNAMICS OF MACHINERY II**  
3 cr. (3 and 0)
- M E 629 THERMAL ENVIRONMENTAL CONTROL**  
3 cr. (3 and 0)
- M E 653 DYNAMIC PERFORMANCE OF VEHICLES**  
3 cr. (3 and 0)
- M E 654 DESIGN OF MACHINE ELEMENTS**  
3 cr. (3 and 0)
- M E 655 DESIGN FOR COMPUTER-AUTOMATED MANUFACTURING**  
3 cr. (3 and 0)
- M E 656 FUNDAMENTALS OF ROBOTICS**  
(E C E 656) 3 cr. (3 and 0)
- M E 693 SELECTED TOPICS IN MECHANICAL ENGINEERING**  
1-6 cr. (3 and 0)
- M E 801 FOUNDATIONS OF FLUID MECHANICS**  
3 cr. (3 and 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. **Prerequisites:** Graduate standing and permission of instructor.
- M E 810 MACROSCOPIC THERMODYNAMICS**  
3 cr. (3 and 0)  
First, second and third laws of thermodynamics with engineering applications; thermodynamic property relations; chemical equilibrium. **Prerequisite:** M E 312 or equivalent.
- M E 811 GAS DYNAMICS**  
3 cr. (3 and 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. **Prerequisite:** Undergraduate course in fluid mechanics.
- M E 812 EXPERIMENTAL METHODS IN THERMAL SCIENCE**  
3 cr. (2 and 2)  
Theories of measurements and instrumentation; 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 cr. (3 and 0)  
Concepts of fluid turbulence; turbulent transport mechanisms, dynamics of turbulence and experimental techniques pertinent to existing theories. Topics address classification of shear flows and their prediction methods. **Prerequisite:** M E 801.
- M E 815 (PHYS 815) STATISTICAL THERMODYNAMICS I**  
3 cr. (3 and 0)  
See PHYS 815 for description.
- M E 818 INTRODUCTION TO FINITE ELEMENT ANALYSIS**  
3 cr. (3 and 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. **Prerequisite:** A numerical methods course or permission of instructor.
- M E 819 COMPUTATIONAL METHODS IN THERMAL SCIENCES**  
3 cr. (3 and 0)  
Numerical techniques as applied to the solution of fluid flow and heat transfer problems; emphasis is primarily on the use of finite difference methods. **Prerequisite:** Graduate standing.
- M E 820 MODERN CONTROL ENGINEERING**  
3 cr. (3 and 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. **Prerequisite:** An undergraduate controls course or permission of instructor.
- M E 821 ADVANCED CONTROL ENGINEERING**  
3 cr. (3 and 0)  
Concepts in multivariable, nonlinear, stochastic and optimal control engineering; design and analysis considerations related to physical machines and processes; mathematical methods as needed. **Prerequisite:** An undergraduate controls course or permission of instructor.
- M E 822 COMPUTER CONTROL OF AUTOMATED MACHINES**  
3 cr. (3 and 0)  
Concepts for control of automated manufacturing machines, cells and processes; logic and switching control; programmable controllers; supervisory hierarchical and expert control systems concepts for manufacturing; closed-loop direct digital control design, including sampling, stability and response of discrete system models; design and application of computer control algorithms; computer requirements; sensors and signal conversion. **Prerequisite:** M E 820 or permission of instructor.



- M E 830 CONDUCTION HEAT TRANSFER**  
3 cr. (3 and 0)  
Analytical and numerical solutions of conduction heat transfer problems; steady one- and two-dimensional systems; extended surfaces; transient solutions; numerical solutions; transform methods. **Prerequisites:** M E 304 or equivalent and Graduate School enrollment.
- M E 831 CONVECTIVE HEAT TRANSFER**  
3 cr. (3 and 0)  
Derivation of continuity, momentum and energy equations for boundary layer flow; solutions for confined and external flow regimes in laminar and turbulent flow. **Prerequisites:** M E 304 or equivalent and MTHSC 208.
- M E 832 RADIATIVE HEAT TRANSFER**  
3 cr. (3 and 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. **Prerequisites:** M E 304 or equivalent and permission of instructor.
- M E 833 HEAT TRANSFER WITH CHANGE OF PHASE**  
3 cr. (3 and 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. **Prerequisites:** M E 304 or equivalent and permission of instructor.
- M E 841 ADVANCED MECHANICAL ENGINEERING DESIGN I**  
3 cr. (3 and 0)  
Design projects selected from industry or government addressed by a graduate student/faculty design team; students are required to create and structure a problem solution, the solution being a preliminary design study encompassing analysis, synthesis, evaluation, economic cost/benefit considerations and engineering project organization. **Prerequisite:** Graduate standing or permission of instructor.
- M E 842 ADVANCED MECHANICAL ENGINEERING DESIGN II**  
3 cr. (3 and 0)  
Case study method of individual design problems and projects; cases used as basis for problem formulation, problem analysis, design theory exemplification and class discussion and evaluation; principles of mechanical and engineering sciences introduced and applied as required for case considerations. **Prerequisite:** M E 306 or equivalent or permission of instructor.
- M E 843 NONLINEAR DYNAMICS OF MECHANICAL SYSTEMS**  
3 cr. (3 and 0)  
Behavior of nonlinear mechanical systems analyzed with numerical, graphical and analytical methods; emphasis on understanding nonlinear effects and methods of analysis. **Prerequisite:** Graduate standing and/or permission of instructor.
- M E 844 RANDOM VIBRATION: THEORY AND MEASUREMENT**  
3 cr. (3 and 0)  
Analysis and measurement of random phenomena. Topics include description of random phenomena (probability theory, response of systems to random phenomena and digital signal processing theory); use of spectrum analyzer and other digital signal recording instruments. **Prerequisites:** M E 302 or MTHSC 208 and permission of instructor.
- M E 845 VIBRATION OF CONTINUOUS MEDIA**  
3 cr. (3 and 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. **Prerequisite:** Permission of instructor.
- M E 854 (E C E 854) ANALYSIS OF ROBOTIC SYSTEMS**  
3 cr. (3 and 0)  
See E C E 854 for description.
- M E 859 (E C E 859) INTELLIGENT ROBOTIC SYSTEMS**  
3 cr. (3 and 0)  
See E C E 859 for description.
- M E 890 ENGINEERING PROJECT**  
1-3 cr. (0 and 3-9)  
Comprehensive analytical and/or experimental treatment of phenomena of current interest in mechanical engineering emphasizing modern technological problems. May be repeated for a maximum of nine credits.
- M E 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- M E 893 SELECTED TOPICS IN MECHANICAL ENGINEERING**  
1-6 cr. (1-6 and 0)  
Topics not covered in other courses. May be repeated for credit.
- M E 930 ADVANCED TOPICS IN HEAT TRANSFER**  
1-6 cr. (1-6 and 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 cr. (3 and 0)  
Topics not covered in other courses. May be repeated for a maximum of six credits.
- M E 932 ADVANCED TOPICS IN THERMODYNAMICS**  
3 cr. (3 and 0)  
Topics not covered in other courses. May be repeated for a maximum of six credits.
- M E 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.



**School of Textiles, Fiber and Polymer Science**

Douglas V. Rippy, Director

Textile and Polymer Science  
Textile Chemistry  
Textile Science

**Textile and Polymer Science**

Douglas V. Rippy, Director, School of Textiles, Fiber and Polymer Science

|                                |               |
|--------------------------------|---------------|
| <b>Major</b>                   | <b>Degree</b> |
| Textile and<br>Polymer Science | Ph.D.         |

Qualification to pursue the degree is accomplished by obtaining a grade of A or B in at least five courses representative of the major areas of textile and polymer science or by standing special examinations in these courses. Courses currently considered representative are TEXT 821, Fiber Physics I; TEXT 835, Textile Structures I; TEXT 866, Fiber Formation; T C 811, Polymer Science I; and T C 812, Polymer Science II.

The student normally takes a minor in a selected field of science or engineering and satisfies the requirements established by the minor department. This usually involves 12-24 credit hours in the minor field. A reading knowledge of one foreign language selected by the advisory committee also is required. Each candidate must carry out an independent, original scientific investigation and formally present and defend the methodology, results and conclusions.

**Textile Chemistry**

Douglas V. Rippy, Director, School of Textiles, Fiber and Polymer Science

|                   |                |
|-------------------|----------------|
| <b>Major</b>      | <b>Degrees</b> |
| Textile Chemistry | M.S., Ph.D.*   |

Applicants must have a bachelor's degree in textile chemistry, textile science, the physical or life sciences, engineering or a related discipline, and must have training in chemistry, physics and mathematics.

The M.S. degree requires a minimum of 24 credit hours of course work and six credit hours of research. Each candidate must complete an independent, scientific or technical investigation and formally present and defend the methodology, results and conclusions in a thesis.

|                |                                                                                                                                      |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------|
| <b>T C 615</b> | <b>INTRODUCTION TO POLYMER SCIENCE AND ENGINEERING</b><br>3 cr. (3 and 0) F                                                          |
| <b>T C 616</b> | <b>CHEMICAL PREPARATION OF TEXTILES</b><br>3 cr. (2 and 3) S                                                                         |
| <b>T C 657</b> | <b>DYEING AND FINISHING I</b><br>3 cr. (3 and 0) F                                                                                   |
| <b>T C 658</b> | <b>DYEING AND FINISHING II</b><br>3 cr. (3 and 0) S                                                                                  |
| <b>T C 659</b> | <b>DYEING AND FINISHING LABORATORY I</b><br>1 cr. (0 and 3) F                                                                        |
| <b>T C 811</b> | <b>POLYMER SCIENCE I</b><br>3 cr. (3 and 0) F<br>Fundamentals of polymer chemistry; chemistry and synthesis of monomers and polymers |

\* A Ph.D. degree with a concentration in textile chemistry is offered jointly by the School of Textiles, Fiber and Polymer Science and the Department of Chemistry.

discussed in relation to the thermodynamics, kinetics and mechanisms of polymerization reactions emphasizing fiber-forming polymers, plastics and composite matrix materials.

**T C 812****POLYMER SCIENCE II**

3 cr. (3 and 0) S

Chemical structure and properties of polymers; polymer solution properties, the viscoelastic state and the crystalline morphology of polymeric materials; the current theories for describing polymer thermal transitions, molecular weight, molecular weight distributions, and transport phenomena in polymeric systems, as well as interfacial phenomena.

**T C 820  
(CH E 820)****COMPOSITE POLYMERIC MATERIALS**

3 cr. (3 and 0) N

See CH E 820 for description.

**T C 840****ANALYTICAL METHODS IN TEXTILE AND POLYMER SCIENCE**

3 cr. (3 and 0) S

Use of chemical and physical instrumental methods to characterize polymeric materials in textile and polymer science; basic principles are discussed and the 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 emphasized. **Prerequisite:** Permission of instructor.

**T C 891****MASTER'S THESIS RESEARCH**

Credit to be arranged.

**Textile Science**

Douglas V. Rippy, Director, School of Textiles, Fiber and Polymer Science

|                 |               |
|-----------------|---------------|
| <b>Major</b>    | <b>Degree</b> |
| Textile Science | M.S.          |

Applicants must have a bachelor's degree in textile chemistry, textile science, the physical or life sciences, engineering or related disciplines, and must have training in chemistry, physics and mathematics.

The M.S. degree (thesis option) requires a minimum of 24 credit hours of course work and six credit hours of research. Each student is required to complete an independent, scientific or technical investigation and formally present and defend the methodology, results and conclusions in a thesis.

The nonthesis option for the Master of Science in textile science requires a total of 36 hours of course work. Successful performance in a comprehensive oral examination also is required.

|                 |                                                                        |
|-----------------|------------------------------------------------------------------------|
| <b>TEXT 611</b> | <b>FABRIC DEVELOPMENT III</b><br>3 cr. (2 and 2) F                     |
| <b>TEXT 616</b> | <b>NONWOVEN STRUCTURES</b><br>3 cr. (2 and 2) S (even numbered years)  |
| <b>TEXT 620</b> | <b>ADVANCED COMPUTER APPLICATIONS IN TEXTILES</b><br>3 cr. (3 and 0) N |
| <b>TEXT 621</b> | <b>FIBER SCIENCE</b><br>3 cr. (2 and 2) F                              |
| <b>TEXT 622</b> | <b>PROPERTIES OF TEXTILE STRUCTURES</b><br>3 cr. (2 and 2) S           |



|                 |                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>TEXT 626</b> | <b>INSTRUMENTATION</b><br>3 cr. (3 and 0) S                                                                                                                                                                                                                                                                                                                                                               |
| <b>TEXT 640</b> | <b>COLOR SCIENCE</b><br>3 cr. (2 and 3) N                                                                                                                                                                                                                                                                                                                                                                 |
| <b>TEXT 660</b> | <b>TEXTILE PROCESSES</b><br>3 cr. (3 and 0) F, S                                                                                                                                                                                                                                                                                                                                                          |
| <b>TEXT 672</b> | <b>TEXTILE INTERNATIONAL TRADE</b><br>3 cr. (3 and 0) N                                                                                                                                                                                                                                                                                                                                                   |
| <b>TEXT 675</b> | <b>TEXTILE MARKETING</b><br>3 cr. (3 and 0) S                                                                                                                                                                                                                                                                                                                                                             |
| <b>TEXT 676</b> | <b>CARPET MANUFACTURING</b><br>3 cr. (3 and 0) S (odd numbered years)                                                                                                                                                                                                                                                                                                                                     |
| <b>TEXT 821</b> | <b>FIBER PHYSICS I</b><br>3 cr. (3 and 0) F<br>Fiber physical properties and their relationship to fiber structure; methods of investigating fiber structure and physical properties; theories of viscoelastic behavior and thermal properties, and models of fiber structure.                                                                                                                            |
| <b>TEXT 822</b> | <b>FIBER PHYSICS II</b><br>3 cr. (3 and 0) S<br>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. <b>Prerequisites:</b> TEXT 821 and MTHSC 208 or permission of instructor.         |
| <b>TEXT 830</b> | <b>TEXTILE PHYSICS</b><br>3 cr. (3 and 0) F<br>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. <b>Prerequisite:</b> Graduate standing.                                                       |
| <b>TEXT 835</b> | <b>TEXTILE STRUCTURES I</b><br>3 cr. (3 and 0) F<br>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.                                                                                                                                        |
| <b>TEXT 845</b> | <b>GEOTEXTILES AND GEOMEMBRANES IN ENGINEERING STRUCTURES</b><br>3 cr. (3 and 0) N<br>Theory and practice of the application of textile materials used in civil engineering constructions, design methods and technological advances; fundamentals of soil mechanics and the manufacture of the textile material; testing and evaluation of the materials. <b>Prerequisite:</b> Permission of instructor. |
| <b>TEXT 846</b> | <b>TEXTILE STRUCTURES II</b><br>3 cr. (3 and 0) S<br>Recent advances in the theoretical and experimental studies on fabric structures, structural mechanics of woven, knitted and nonwoven                                                                                                                                                                                                                |

fabrics; relationship between yarn geometry and fabric structure; design of industrial fabrics and laminated structures. **Prerequisite:** Permission of instructor.

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| <b>TEXT 866</b> | <b>FIBER FORMATION</b><br>3 cr. (3 and 0) S<br>Formation of fibers by wet, dry and melt spinning, emphasizing rheology of solutions and melts, fiber structure, stretching and drawing processes; interrelationships of polymer properties and processes that determine fiber properties.                  |
| <b>TEXT 870</b> | <b>ADVANCES IN TEXTILE MANUFACTURING</b><br>3 cr. (3 and 0) N<br>Comparisons among cotton, woolen and worsted processing systems with respect to suitability to fiber characteristics, processing of fiber blends, modern yarn production, non-woven fabrics and latest developments in textile machinery. |
| <b>TEXT 880</b> | <b>SELECTED TOPICS</b><br>3 cr. (3 and 0) N<br>Topics not covered in other textile chemistry or textile science courses.                                                                                                                                                                                   |
| <b>TEXT 891</b> | <b>MASTER'S THESIS RESEARCH</b><br>Credit to be arranged.                                                                                                                                                                                                                                                  |
| <b>TEXT 991</b> | <b>DOCTORAL DISSERTATION RESEARCH</b><br>Credit to be arranged.                                                                                                                                                                                                                                            |

*These programs are directed by a council of the department chairs.*

Agricultural Engineering  
Chemistry  
Civil Engineering  
Computer Engineering  
Computer Science  
Electrical Engineering  
Management Science  
Mathematical Sciences  
Physics

### **Agricultural Engineering**

Richard O. Hegg, Chair, Department of Agricultural and Biological Engineering

**Major**  
Agricultural  
Engineering

**Degrees**  
M.Engr., M.S., Ph.D.

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

Candidates for the M.Engr. degree must complete a minimum of 30 hours of course work as outlined by the advisory committees. A thesis is not required for this degree. Candidates for the M.S. degree are required to complete a minimum of 24 hours of course work plus an additional six hours of thesis research.

Candidates for the Ph.D. degree are required to complete an additional 36 semester hours of course work beyond the M.S. degree. Also required are the completion of 18 hours of dissertation research and the submission of an acceptable dissertation.



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| <b>AG E 608</b><br>(E S E 608)<br>(AGRON 608) | <b>LAND TREATMENT OF WASTEWATER AND SLUDGES</b><br>3 cr. (3 and 0) F                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>AG E 616</b>                               | <b>MECHANICAL DESIGN FOR AGRICULTURAL AND BIOLOGICAL SYSTEMS</b><br>3 cr. (2 and 3) S                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>AG E 628</b><br>(CH E 628)                 | <b>BIOCHEMICAL ENGINEERING</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>AG E 630</b><br>(BIOSC 630)                | <b>ENGINEERING MODELING OF BIOLOGICAL SYSTEMS</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>AG E 631</b>                               | <b>AGRICULTURAL STRUCTURES AND ENVIRONMENTAL DESIGN</b><br>3 cr. (2 and 3) F                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>AG E 642</b>                               | <b>PROPERTIES AND PROCESSING OF BIOLOGICAL PRODUCTS</b><br>3 cr. (2 and 3) S                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>AG E 650</b>                               | <b>INSTRUMENTATION FOR AGRICULTURAL AND BIOLOGICAL SYSTEMS</b><br>3 cr. (2 and 3)                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>AG E 651</b><br>(E S E 651)<br>(FOR 651)   | <b>NEWMAN SEMINAR AND LECTURE SERIES IN NATURAL RESOURCES ENGINEERING</b><br>1 cr. (0 and 2) S, F                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>AG E 658</b><br>(BIOSC 658)                | <b>CELL PHYSIOLOGY</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>AG E 684</b><br>(E S E 684)<br>(I E 684)   | <b>MUNICIPAL SOLID WASTE MANAGEMENT</b><br>3 cr. (3 and 0) S                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>AG E 781</b>                               | <b>SPECIAL PROBLEMS</b><br>1-3 cr. (1-3 and 0)<br>Student selects subject and conducts library, laboratory and/or field research; technical report documenting study required. May be repeated for maximum of six credits. For Master of Engineering degree candidates only.                                                                                                                                                                                                         |
| <b>AG E 811</b>                               | <b>TILLAGE AND SOIL DYNAMICS</b><br>3 cr. (3 and 0)<br>Physical and dynamic properties of soil related to actions of tillage tools, tractive vehicles and plant growth and development; soil strength parameters; seedling environment and emergence; mechanics of tillage implements; soil compaction causes and effects; tractive efforts of wheel and track-type vehicles; off-the-road locomotion. <b>Prerequisite:</b> AG E 416/616 or equivalent.                              |
| <b>AG E 865</b>                               | <b>HEAT AND MOISTURE TRANSFER IN BIOLOGICAL MATERIALS</b><br>3 cr. (3 and 0)<br>Heat and moisture diffusion in biological materials; criteria for selecting proper operational mathematics to solve certain boundary value problems; integral transforms of Laplace, Fourier and Hankel applied to various geometric configurations; influence of respiration heat and transpiration moisture production. <b>Prerequisite:</b> MTHSC 453/653 or 434/634 or permission of instructor. |

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| <b>AG E 871</b> | <b>SELECTED TOPICS IN AGRICULTURAL ENGINEERING</b><br>1-3 cr. (1-3 and 0)<br>Supervised, in-depth study of an area not covered in other courses; performance measured by oral and written reports and/or by examination. May be repeated for a maximum of six credits.                                                                                                                 |
| <b>AG E 882</b> | <b>SYSTEMS ENGINEERING</b><br>3 cr. (3 and 0)<br>Systems analysis methods applied to engineering of biological and agricultural operations; development of equations of motion, system analogs, and computer models and simulations; linear control analysis; and stability. <b>Prerequisite:</b> Permission of instructor.                                                            |
| <b>AG E 891</b> | <b>MASTER'S THESIS RESEARCH</b><br>Credit to be arranged.                                                                                                                                                                                                                                                                                                                              |
| <b>AG E 901</b> | <b>SPECIAL PROBLEMS IN AGRICULTURAL ENGINEERING</b><br>3 cr. (3 and 0)<br>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; technical report required. |
| <b>AG E 991</b> | <b>DOCTORAL DISSERTATION RESEARCH</b><br>Credit to be arranged.                                                                                                                                                                                                                                                                                                                        |

## Chemistry

Joseph W. Kolis, Chair, Department of Chemistry

| Major     | Degrees     |
|-----------|-------------|
| Chemistry | M.S., Ph.D. |

Master of Science degree candidates must complete 24 hours of course work and six hours of research culminating in a satisfactory thesis.

Students in both the M.S. and Ph.D. degree programs must present satisfactory research seminars and must complete, or have completed, a computer science course equivalent to Clemson University's CP SC 110. In some instances, the computer science course requirement may be waived for candidates for the M.S. degree who have completed satisfactorily undergraduate courses in French, German or Russian. Students in the Ph.D. program must pass a language requirement in French, German or Russian. Admission to candidacy for the Ph.D. degree requires completion of either a cumulative or a comprehensive examination in the area of concentration. The primary requirement for the Ph.D. degree is the performance of original research leading to a dissertation. Doctor of Philosophy degree candidates must qualify to pursue the Ph.D. degree by completing a core of four courses during the first two years of study. Qualification requirements may also be satisfied by examination.

A Ph.D. degree in chemistry with a concentration in textile chemistry is offered jointly with the School of Textiles, Fiber and Polymer Science.

|               |                                                   |
|---------------|---------------------------------------------------|
| <b>CH 602</b> | <b>INORGANIC CHEMISTRY</b><br>3 cr. (3 and 0) F   |
| <b>CH 611</b> | <b>INSTRUMENTAL ANALYSIS</b><br>4 cr. (2 and 6) S |



- CH 621 ADVANCED ORGANIC CHEMISTRY**  
3 cr. (3 and 0)
- CH 627 ORGANIC SPECTROSCOPY**  
3 cr. (2 and 3) S (odd numbered years)
- CH 631 PHYSICAL CHEMISTRY I**  
3 cr. (3 and 0) F, S
- CH 632 PHYSICAL CHEMISTRY II**  
3 cr. (3 and 0) F, S
- CH 635 ATOMIC AND MOLECULAR STRUCTURE**  
3 cr. (3 and 0) S
- CH 639 PHYSICAL CHEMISTRY LABORATORY I**  
1 cr. (0 and 3) F
- CH 640 PHYSICAL CHEMISTRY LABORATORY II**  
1 cr. (0 and 3) S
- CH 700 PHYSICAL SCIENCE IN ELEMENTARY SCHOOL — CHEMISTRY**  
3 cr. (2 and 3) N  
Basic chemical principles and their applications to everyday life; selecting, carrying out and discussing short, safe, inexpensive experiments to illustrate the principles. Restricted to graduate students in elementary education. Graduate students in secondary education may take the course by special permission of the instructor.
- CH 804 FUNDAMENTAL PRINCIPLES OF INORGANIC CHEMISTRY**  
3 cr. (3 and 0) F  
Fundamental principles of modern inorganic chemistry showing their relationship to other areas of chemistry.
- CH 805 THEORETICAL INORGANIC CHEMISTRY**  
3 cr. (3 and 0) S (odd numbered years)  
Application of group theory to structure and properties of inorganic molecules. **Prerequisites:** CH 435/635 and 804 or permission of instructor.
- CH 806 PHYSICAL METHODS IN INORGANIC CHEMISTRY**  
3 cr. (3 and 0) S (odd numbered years)  
Theory and application of infrared, Raman, visible, ultraviolet, NMR, ESR, NQR, Mössbauer and mass spectrometry to inorganic chemistry. **Prerequisite:** CH 804 or permission of instructor.
- CH 807 CHEMISTRY OF THE TRANSITION ELEMENTS**  
3 cr. (3 and 0) F  
Structure, spectroscopy and reactivity of transition metals and their compounds. **Prerequisite:** CH 804 or permission of instructor.
- CH 808 CHEMISTRY OF THE NONMETALLIC ELEMENTS**  
3 cr. (3 and 0) S (odd numbered years)  
Development and application of a bonding model for descriptive inorganic chemistry of boron, carbon, silicon, nitrogen, phosphorus, oxygen and sulfur. **Prerequisite:** CH 804 or permission of instructor.
- CH 809 CHEMICAL APPLICATIONS OF X-RAY CRYSTALLOGRAPHY**  
3 cr. (2 and 2) S (odd numbered years)  
Topics include a physical description of the crystalline state, symmetry in crystals, X-ray diffraction, modern methods of structure determination and chemical interpretation of structural results. **Prerequisite:** CH 331, 332 or permission of instructor.
- CH 811 ANALYTICAL CHEMISTRY**  
3 cr. (3 and 0) F  
Graduate-level review of modern analytical chemistry; literature, sampling, quality control/assurance, chemometrics and the use of modern analytical methods are stressed; team taught by the analytical faculty.
- CH 812 CHEMICAL SPECTROSCOPIC METHODS**  
3 cr. (2 and 3) S  
Emission and absorption spectroscopy, chemical microscopy, X-ray diffraction and fluorescence techniques in analytical chemistry; theory and operation of instruments.
- CH 816 SEPARATION SCIENCE**  
3 cr. (3 and 0) S (odd numbered years)  
Fundamental thermodynamic and kinetic concepts of separation and practical aspects of current separation techniques used in analytical chemistry.
- CH 820 FUNDAMENTALS OF ORGANIC SYNTHESIS**  
3 cr. (3 and 0) F  
Modern aspects of organic chemistry emphasizing the mechanisms of reactions and synthesis of molecules of current interest. **Prerequisites:** CH 224 or equivalent plus satisfactory performance in the organic placement examination or permission of instructor.
- CH 821 ORGANIC CHEMISTRY I**  
3 cr. (3 and 0) F  
Theoretical concepts of organic chemistry, stereochemistry and mechanisms of organic reactions. **Prerequisite:** CH 421/621 or satisfactory performance on the organic chemistry placement examination.
- CH 822 ORGANIC CHEMISTRY II**  
3 cr. (3 and 0) S  
Continuation of CH 821; mechanisms of organic reactions including photochemistry and Woodward-Hoffman rules; modern synthetic organic chemistry. **Prerequisite:** CH 821 or permission of instructor.
- CH 825 CHEMISTRY OF HETEROCYCLIC COMPOUNDS**  
3 cr. (3 and 0) S (odd numbered years)  
Chemistry of heterocyclic compounds of nitrogen, oxygen, sulfur and other elements. **Prerequisites:** CH 821 and/or CH 822 or permission of instructor.
- CH 830 FUNDAMENTALS OF PHYSICAL CHEMISTRY**  
3 cr. (3 and 0) F  
Principles of classical thermodynamics, chemical kinetics and quantum chemistry. **Prerequisite:** CH 331/631 or equivalent.



- CH 831**      **CHEMICAL THERMODYNAMICS**  
3 cr. (3 and 0) F (odd numbered years)  
Classical thermodynamics emphasizing theory and significance of energetics and systems of variable composition. **Prerequisite:** CH 331/631 or equivalent.
- CH 834**      **STATISTICAL THERMODYNAMICS**  
3 cr. (3 and 0) S (odd numbered years)  
Statistical thermodynamics: ensemble method, ideal gases, internal degrees of freedom, solid state, imperfect gases, distribution function method in fluids and time-dependent fluctuations. **Prerequisite:** CH 831.
- CH 835**      **CHEMICAL KINETICS**  
3 cr. (3 and 0) S (odd numbered years)  
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 supplemented by assigned problems, paper and oral examination of topic of special interest to student.
- CH 837**      **QUANTUM CHEMISTRY**  
3 cr. (3 and 0) F (odd numbered years)  
Mathematical and conceptual formulation of quantum theory of electronic structure of atoms and molecules; eigenvalue solution of one-dimensional Schrodinger equation and application of this method to chemical problems.
- CH 840**      **TECHNIQUES OF EXPERIMENTAL CHEMISTRY**  
3 cr. (1 and 6) F, S  
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 851**      **SEMINAR**  
1-2 cr. F, S  
Students and faculty review current topics in chemistry. May be taken more than one semester.
- CH 861**      **PRINCIPLES OF BIOCHEMISTRY**  
3 cr. (3 and 0) N  
Rigorous, quantitative treatment of properties of biological molecules using modern techniques of organic, physical and analytical chemistry to study structural relationships and biological activity. **Prerequisites:** Satisfactory performance on placement examinations in organic and physical chemistry.
- CH 891**      **MASTER'S THESIS RESEARCH**  
Credit to be arranged. F, S, SS
- CH 900**      **SELECTED TOPICS IN INORGANIC CHEMISTRY**  
1-4 cr. (1-4 and 0) N  
Metal-metal bonding; homogeneous catalysis; photochemistry; bioinorganic chemistry. Topics

vary with interests of students. May be repeated for credit, but only if different topics are covered.

- CH 910**      **SELECTED TOPICS IN ANALYTICAL CHEMISTRY**  
1-4 cr. (1-4 and 0) N  
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 cr. (1-4 and 0) N  
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 cr. (1-4 and 0) N  
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**  
Credit to be arranged. F, S, SS
- Civil Engineering**  
Russell H. Brown, Chair, Department of Civil Engineering
- | Major             | Degrees              |
|-------------------|----------------------|
| Civil Engineering | M.Engr., M.S., Ph.D. |
- Two options are offered for the M.S. degree. The nonthesis option requires 33 hours of course work and a written and oral examination. The thesis option requires 30 hours of course work, six of which are thesis research. All graduate students are required to complete C E 895 and an oral examination as a requirement for any graduate degree.
- C E 603**      **USE OF COMPUTERS IN STRUCTURAL ANALYSIS AND DESIGN**  
3 cr. (3 and 0)
- C E 604**      **MASONRY STRUCTURAL DESIGN**  
3 cr. (3 and 0)
- C E 605**      **STRUCTURAL SYSTEMS DESIGN**  
3 cr. (3 and 0)
- C E 610**      **TRAFFIC ENGINEERING OPERATIONS**  
3 cr. (3 and 0) S
- C E 612**      **URBAN TRANSPORTATION PLANNING**  
3 cr. (3 and 0) F
- C E 617**      **AIRPHOTO INTERPRETATION**  
3 cr. (2 and 3) S



- C E 630**      **GEOTECHNICAL ENGINEERING DESIGN**  
3 cr. (3 and 0)
- C E 632**      **CONSTRUCTION PROJECT ADMINISTRATION**  
3 cr. (3 and 0)
- C E 633**      **CONSTRUCTION PLANNING AND SCHEDULING**  
3 cr. (3 and 0)
- C E 634**      **CONSTRUCTION ESTIMATING AND PROJECT CONTROL**  
3 cr. (3 and 0)
- C E 638**      **CONSTRUCTION SUPPORT OPERATIONS**  
3 cr. (3 and 0)
- C E 639**      **CONSTRUCTION EQUIPMENT SELECTION AND MAINTENANCE**  
3 cr. (3 and 0)
- C E 653**      **STRUCTURAL ANALYSIS II**  
3 cr. (3 and 0)
- C E 662**      **COASTAL ENGINEERING I**  
3 cr. (3 and 0)
- C E 664**      **PHYSICAL MODELS IN FLUID MECHANICS**  
3 cr. (2 and 2)
- C E 680**      **WIND ENGINEERING**  
3 cr. (2 and 2)
- C E 682**      **GROUNDWATER AND CONTAMINANT TRANSPORT**  
(E S E 682) 3 cr. (3 and 0) S
- C E 801**      **MATRIX METHODS OF STRUCTURAL ANALYSIS**  
3 cr. (3 and 0)  
Matrix methods of structural analysis; development of member stiffness and flexibility matrices; procedures used to employ matrix methods; student writes and/or uses computer programs to analyze and design complex structures such as continuous span bridges, tall and low-rise buildings, towers, arches and truss domes. **Prerequisite:** C E 453/653 or permission of instructor.
- C E 802**      **PRESTRESSED CONCRETE ANALYSIS AND DESIGN**  
3 cr. (3 and 0)  
Analysis and design of prestressed concrete beams, columns and slabs; loss of prestress; balanced design concept; cable layout; continuous spans; anchorage details. **Prerequisite:** C E 402.
- C E 803**      **REINFORCED CONCRETE STRUCTURAL SYSTEMS**  
3 cr. (3 and 0)  
Second course in design of reinforced concrete structures; advanced concepts in analysis and design of beams, columns and slabs; effect of past and present research in formulation of reinforced concrete design codes; behavior and design of two-way floor systems. **Prerequisite:** C E 402.
- C E 806**      **DYNAMIC ANALYSIS OF STRUCTURES**  
3 cr. (3 and 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. **Prerequisite:** C E 801 or permission of instructor.
- C E 807**      **NUMERICAL METHODS IN CIVIL ENGINEERING**  
3 cr. (3 and 0)  
Application of numerical methods to the solution of civil engineering problems. Topics include solution of linear and nonlinear equations and systems of equations, numeric integration and differentiation, eigenvalues and eigenvectors, methods for integration of ordinary differential equations, finite difference methods and series solution. **Prerequisite:** C E 305 or permission of instructor.
- C E 808**      **FINITE ELEMENT METHOD IN ENGINEERING**  
3 cr. (3 and 0)  
Basic concepts of finite element analysis; development of simple triangular, rectangular and quadrilateral elements in plane stress, plane strain and axisymmetric cases; plate bending; shell and three-dimensional elements; higher order elements and relative advantages and disadvantages of their use; applications of the method to problems of heat flow, seepage, dynamics and inelastic behavior. **Prerequisite:** C E 801 or permission of instructor.
- C E 811**      **HIGHWAY GEOMETRIC DESIGN**  
3 cr. (2 and 3)  
Geometric design of roadways, at-grade intersections and interchanges in accordance with conditions imposed by driver ability, vehicle performance, safety and economics. **Prerequisite:** C E 410/610.
- C E 813**      **HIGHWAY AND AIRPORT PAVEMENT DESIGN**  
3 cr. (3 and 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. **Prerequisite:** C E 330.
- C E 815**      **TRANSPORTATION SAFETY ENGINEERING**  
3 cr. (3 and 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. **Prerequisite:** C E 310.



- C E 816 HIGHWAY PLANNING**  
3 cr. (3 and 0)  
Various aspects of highway planning: planning surveys, needs studies, impact studies, sufficiency ratings, highway finance, highway administration, and extensive treatment of economic evaluation of alternative highway projects by benefit cost ratio, annual cost, rate of return and investment return procedures.
- C E 817 MASS TRANSIT PLANNING**  
3 cr. (3 and 0)  
Mass transit planning; characteristics of modern mass transit systems; case studies of mass transit in selected cities; transit studies; marketing and financing mass transit; recent innovation in mass transit; current issues in mass transit planning; future developments in mass transit.
- C E 818 AIRPORT PLANNING AND DESIGN**  
3 cr. (3 and 0)  
Planning and design of airports and other air transportation facilities; characteristics of air transport; future role of air transport in overall transportation program.
- C E 819 TRANSPORTATION RESEARCH**  
2-4 cr.  
Independent investigation of problems in transportation engineering.
- C E 823 ASPHALT CONCRETE PROPERTIES**  
3 cr. (3 and 0)  
Identification and suitability of aggregates for construction; characteristics and properties of bituminous materials; materials behavior, construction and design problems; some use of microcomputers and the mainframe. **Prerequisite:** C E 320 or equivalent.
- C E 830 ADVANCED SOIL MECHANICS**  
3 cr. (3 and 0)  
Stresses in soils; plastic equilibrium of soil masses; failure conditions; earth pressures; analysis of flexible retaining wall bulkheads; solution of problem by elastic theory. **Prerequisite:** C E 330.
- C E 831 FOUNDATION ENGINEERING**  
3 cr. (3 and 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. **Prerequisite:** C E 830 or permission of instructor.
- C E 833 ANALYSIS AND DESIGN OF DEEP FOUNDATIONS**  
3 cr. (3 and 0)  
Methods for predicting bearing capacity and settlement of single piles, pile groups and drilled shafts; analysis and design of pile and pier foundations for resisting axial, lateral and uplifting loads; load test interpretation and evaluation. **Prerequisite:** C E 830 or permission of instructor.
- C E 835 CONSTRUCTION PROJECT MODELING**  
3 cr. (3 and 0)  
Mathematical and computer models to simulate construction operations; linear models and optimization applications to construction materials, scheduling and equipment allocation; typical computer models used in construction; simple modeling examples. **Prerequisite:** C E 324 or permission of instructor.
- C E 836 CIVIL ENGINEERING QUALITY MANAGEMENT**  
3 cr. (3 and 0)  
Principles of total quality management (TQM) and their applications in the engineering and construction industry; TQM implementation techniques, with particular emphasis on the construction environment; concepts of quality assurance (QA) and quality control (QC) in construction. **Prerequisite:** Permission of instructor.
- C E 837 CONSTRUCTION SPECIFICATIONS AND CONTRACTS**  
3 cr. (3 and 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. **Prerequisite:** C E 324 or equivalent.
- C E 838 MATERIALS MANAGEMENT**  
3 cr. (3 and 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. **Prerequisite:** Permission of instructor.
- C E 839 EXPERT SYSTEMS APPLICATIONS IN CIVIL ENGINEERING**  
3 cr. (3 and 0)  
Applications of expert systems in civil engineering design, construction and facility management; use of expert systems shells for expert systems development; linking expert systems to external programs; knowledge acquisition and system validation.
- C E 840 PROJECT MANAGEMENT APPLICATIONS**  
3 cr. (3 and 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. **Prerequisites:** C E 433 and 434 or equivalent.
- C E 846 FLOW IN OPEN CHANNELS**  
3 cr. (3 and 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; some applications of unsteady flow.

**Prerequisites:** Graduate standing and permission of instructor.

- C E 851 RELIABILITY ANALYSIS AND DESIGN IN CIVIL ENGINEERING**  
3 cr. (3 and 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. **Prerequisite:** Permission of instructor.
- C E 852 (E M 852) ADVANCED FINITE ELEMENT ANALYSIS**  
3 cr. (3 and 0)  
See E M 852 for description.
- C E 860 ADVANCED FLUID MECHANICS**  
3 cr. (3 and 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 cr. (3 and 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. **Prerequisite:** C E 422 or equivalent.
- C E 863 COASTAL ENGINEERING II**  
3 cr. (3 and 0)  
Littoral processes; coastal structures; port engineering; estuarial hydromechanics; littoral transport; port and harbor design; functional design of coastal structures; tidal dynamics in estuaries. **Prerequisite:** C E 462/662.
- C E 865 HYDROLOGIC SYSTEMS ANALYSIS**  
3 cr. (3 and 0)  
Hydrologic cycle as a hydrologic system; deterministic hydrology; all 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. **Prerequisite:** Permission of instructor.
- C E 875 NUMERICAL MODELS IN HYDRAULICS**  
3 cr. (3 and 0)  
Finite difference and finite element methods used to solve hydraulic engineering problems; class assignments include the development of a finite difference model and the use of an existing finite element model to solve problems in coastal engineering and river mechanics. **Prerequisite:** C E 422.
- C E 889 SPECIAL PROBLEMS I**  
1-3 cr.  
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 cr.  
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**  
Credit to be arranged.
- C E 893 SELECTED TOPICS IN CIVIL ENGINEERING**  
1-6 cr. (1-6 and 1-6)  
Topics not covered in other courses. May be repeated for credit.
- C E 895 CIVIL ENGINEERING SEMINAR**  
1 cr. (0 and 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**  
Credit to be arranged.

## Computer Engineering

Kelvin F. Poole, Chair, Department of Electrical and Computer Engineering

| Major                | Degrees     |
|----------------------|-------------|
| Computer Engineering | M.S., Ph.D. |

For the M.S. 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 course work must be completed.

Specially qualified candidates with a B.S. degree may apply for direct entry to the Ph.D. program. The program of study and hours required beyond the baccalaureate degree are specified by the focus area, but must be at least 66 including course work and research credit.

- E C E 606 INTRODUCTION TO MICROELECTRONICS PROCESSING**  
3 cr. (3 and 0) S
- E C E 607 VLSI RELIABILITY**  
3 cr. (3 and 0) S
- E C E 617 ELEMENTS OF SOFTWARE ENGINEERING**  
3 cr. (3 and 0) F, S
- E C E 618 POWER SYSTEM ANALYSIS**  
3 cr. (3 and 0) F
- E C E 619 ELECTRIC MACHINERY**  
3 cr. (3 and 0) S
- E C E 622 OPERATIONAL AMPLIFIER CIRCUITS**  
3 cr. (2 and 2) S
- E C E 623 POWER SYSTEM PROTECTION**  
3 cr. (3 and 0) S
- E C E 626 DIGITAL COMPUTER DESIGN**  
3 cr. (3 and 0) F, S



|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>E C E 629</b> | <b>ORGANIZATION OF COMPUTERS</b><br>3 cr. (3 and 0) F, S                                                                                                                                                                                                                                                                                                                                                                              | <b>E C E 838</b> | <b>SPECIAL TOPICS IN ELECTROMAGNETICS*</b><br>1 cr. (1 and 0)                                                                                                                                                                                                                                                                                                                                                                            |
| <b>E C E 631</b> | <b>DIGITAL ELECTRONICS</b><br>3 cr. (2 and 2) F, S                                                                                                                                                                                                                                                                                                                                                                                    | <b>E C E 839</b> | <b>INTEGRAL EQUATIONS IN ELECTROMAGNETICS*</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                        |
| <b>E C E 633</b> | <b>SENSORS AND MICROCOMPUTER CONTROL FOR ROBOTS</b><br>3 cr. (1 and 4) F                                                                                                                                                                                                                                                                                                                                                              | <b>E C E 841</b> | <b>DISTRIBUTED COMPUTING AND NETWORKS</b><br>3 cr. (3 and 0) S<br>Design oriented toward distributed computing and computing concepts; design issues; implementation techniques; communication networks; analytical tools for system evaluation; data transmission principles; data concentration. <b>Prerequisite:</b> E C E 438/638.                                                                                                   |
| <b>E C E 636</b> | <b>TRANSMISSION LINES AND MICROWAVE CIRCUITS</b><br>3 cr. (3 and 0) F                                                                                                                                                                                                                                                                                                                                                                 | <b>E C E 842</b> | <b>COMPUTER ARCHITECTURE</b><br>3 cr. (3 and 0) S<br>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. <b>Prerequisite:</b> E C E 429 or equivalent.                                                                                                                          |
| <b>E C E 638</b> | <b>COMPUTER COMMUNICATIONS</b><br>3 cr. (3 and 0) F                                                                                                                                                                                                                                                                                                                                                                                   | <b>E C E 844</b> | <b>DIGITAL SIGNAL PROCESSING*</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>E C E 639</b> | <b>FIBER OPTICS</b><br>3 cr. (3 and 0) F                                                                                                                                                                                                                                                                                                                                                                                              | <b>E C E 845</b> | <b>COMPUTER SYSTEM DESIGN AND OPERATION</b><br>3 cr. (3 and 0)<br>Factors involved in design, acquisition and operation of a computer system; analysis methods; alternative computer systems; computer economics; performance evaluation; operational requirements. <b>Prerequisite:</b> Permission of instructor.                                                                                                                       |
| <b>E C E 640</b> | <b>PERFORMANCE ANALYSIS OF LOCAL COMPUTER NETWORKS</b><br>3 cr. (3 and 0) S                                                                                                                                                                                                                                                                                                                                                           | <b>E C E 846</b> | <b>DIGITAL PROCESSING OF SPEECH SIGNALS*</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                          |
| <b>E C E 642</b> | <b>KNOWLEDGE ENGINEERING</b><br>3 cr. (3 and 0) F                                                                                                                                                                                                                                                                                                                                                                                     | <b>E C E 847</b> | <b>DIGITAL IMAGE PROCESSING*</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>E C E 646</b> | <b>ANTENNAS AND PROPAGATION</b><br>3 cr. (3 and 0) S                                                                                                                                                                                                                                                                                                                                                                                  | <b>E C E 848</b> | <b>TELECOMMUNICATION NETWORK MODELING AND ANALYSIS</b><br>3 cr. (3 and 0)<br>Protocols, modeling and analysis of telecommunication networks, with emphasis on quantitative performance modeling of networks and systems using packet-switching and circuit-switching techniques. <b>Prerequisite:</b> E C E 438/638 or CP SC 825.                                                                                                        |
| <b>E C E 652</b> | <b>PROGRAMMING SYSTEMS</b><br>3 cr. (3 and 0) S                                                                                                                                                                                                                                                                                                                                                                                       | <b>E C E 849</b> | <b>ADVANCED TOPICS IN COMPUTER COMMUNICATIONS</b><br>3 cr. (3 and 0)<br>Performance analysis and design of computer communication networks with emphasis on recent developments. Topics include such issues as routing flow control, error control and end-to-end performance analysis, local area, packet radio and long haul store-and-forward networks. <b>Prerequisites:</b> E C E 438/638 or 440/640, and permission of instructor. |
| <b>E C E 653</b> | <b>SOFTWARE PRACTICUM</b><br>3 cr. (1 and 6)                                                                                                                                                                                                                                                                                                                                                                                          |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>E C E 660</b> | <b>COMPUTER-AIDED ANALYSIS AND DESIGN</b><br>3 cr. (3 and 0) F                                                                                                                                                                                                                                                                                                                                                                        |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>E C E 667</b> | <b>INTRODUCTION TO DIGITAL SIGNAL PROCESSING</b><br>3 cr. (3 and 0) F, S                                                                                                                                                                                                                                                                                                                                                              |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>E C E 668</b> | <b>THE EMBEDDED MICROPROCESSOR</b><br>3 cr. (2 and 2) S                                                                                                                                                                                                                                                                                                                                                                               |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>E C E 692</b> | <b>SPECIAL PROBLEMS</b><br>1-3 cr. (0 and 2)                                                                                                                                                                                                                                                                                                                                                                                          |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>E C E 693</b> | <b>SELECTED TOPICS</b><br>1-3 cr. (1-3 and 0)                                                                                                                                                                                                                                                                                                                                                                                         |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>E C E 801</b> | <b>ANALYSIS OF LINEAR SYSTEMS*</b><br>3 cr. (3 and 0) F                                                                                                                                                                                                                                                                                                                                                                               |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>E C E 802</b> | <b>ELECTRIC MOTOR CONTROL*</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                     |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>E C E 811</b> | <b>INTEGRATED CIRCUIT DESIGN</b><br>3 cr. (2 and 2)<br>Design concepts and factors influencing the choice of technology; fundamental MOS device design; silicon foundries; custom and semi-custom 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. <b>Prerequisite:</b> E C E 459/659. |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                          |

\* Descriptions of these courses are listed under Electrical Engineering.



- E C E 850 COMPUTATION AND SIMULATION**  
3 cr. (3 and 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 cr. (3 and 0)  
Analysis and design of multiprocessor and modular computer systems. Topics include recent developments in integration, fabrication and application of multiprocessor systems. **Prerequisite:** E C E 842.
- E C E 852 SOFTWARE ENGINEERING**  
3 cr. (3 and 0) F  
Design, construction verification and testing of large-scale computer software systems. Topics include software science, requirements writing, design graphics, the calculus of programs, verification proofs and symbolic execution. **Prerequisite:** Computer engineering major or permission of instructor.
- E C E 855 ARTIFICIAL INTELLIGENCE**  
3 cr. (3 and 0)  
Emulating intelligent behavior by computer. Topics include 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 data base structure and inference strategies; examples of LISP, PROLOG and OPS5. **Prerequisite:** E C E 442/642.
- E C E 856 PATTERN RECOGNITION\***  
3 cr. (3 and 0)
- E C E 872 ARTIFICIAL NEURAL NETWORKS**  
3 cr. (3 and 0)  
Design, analysis and application of artificial neural networks. Topics include neuron models, network architectures, training (supervised and unsupervised) and hardware implementation; extended studies of selected applications and simulation exercises. **Prerequisites:** MTHSC 311 or permission of instructor, and graduate standing.
- E C E 890 ENGINEERING REPORT RESEARCH**  
Variable credit hours.  
Research culminating in writing an engineering report to satisfy one of the requirements for the nonthesis option for the Master of Science degree; the engineering report is similar to the thesis but requires only departmental approval. Graded on a pass/fail basis.
- E C E 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- E C E 892 SPECIAL PROBLEMS IN ELECTRICAL AND COMPUTER ENGINEERING**  
1-3 cr. (1-3 and 0)  
Term paper, special design or other problems in electrical and computer engineering approved by the instructor; not to be used for

investigation associated with the M.S. thesis or the engineering report. May be repeated for additional credit.

- E C E 893 SELECTED TOPICS IN ELECTRICAL AND COMPUTER ENGINEERING**  
1-3 cr. (1-3 and 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 additional credit. **Prerequisite:** Permission of instructor.
- E C E 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

## Computer Science

Stephen T. Hedetniemi, Chair, Department of Computer Science

| Major            | Degrees     |
|------------------|-------------|
| Computer Science | M.S., Ph.D. |

For unconditional admission to graduate study in computer science, students must have completed 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.

A candidate for the M.S. degree must complete satisfactorily an approved program of at least 30 graduate hours. There are three options available to the student to satisfy the degree requirements. Option 1 requires course work only, followed by a written examination. Option 2 requires a research paper, and Option 3 requires a thesis. Students may take up to six hours of approved courses in areas outside the department.

Although formal course requirements for the Ph.D. degree are minimal, a typical program requires two to four years of effort beyond the M.S. degree. Each candidate is required to pass a qualifying examination, a comprehensive examination, a dissertation proposal and a defense of the dissertation.

- CP SC 605 INTRODUCTION TO GRAPHICAL SYSTEMS DESIGN**  
3 cr. (3 and 0) F
- CP SC 622 INTRODUCTION TO OPERATING SYSTEMS**  
3 cr. (3 and 0)
- CP SC 623 IMPLEMENTATION OF OPERATING SYSTEMS**  
3 cr. (2 and 2)
- CP SC 628 DESIGN AND IMPLEMENTATION OF PROGRAMMING LANGUAGES**  
3 cr. (3 and 0)
- CP SC 629 TRANSLATION OF PROGRAMMING LANGUAGES**  
3 cr. (3 and 0)
- CP SC 630 COMPUTER PERFORMANCE EVALUATION**  
3 cr. (3 and 0) F (odd numbered years)
- CP SC 635 MICROPROGRAMMING**  
3 cr. (3 and 0) S (odd numbered years)

\* Description of this course is listed under Electrical Engineering.



|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CP SC 650 | <b>THEORY OF COMPUTATION</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                                        | CP SC 823 | <b>OPERATING SYSTEMS DESIGN</b><br>3 cr. (3 and 0) F<br>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. <b>Prerequisites:</b> MTHSC 401/601 and CP SC 423/623.                                                                |
| CP SC 662 | <b>DATA BASE MANAGEMENT SYSTEMS</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                                 | CP SC 824 | <b>ADVANCED OPERATING SYSTEMS</b><br>3 cr. (3 and 0) S<br>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. <b>Prerequisite:</b> CP SC 623 or permission of instructor.                                                               |
| CP SC 663 | <b>ON-LINE SYSTEMS</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                                              | CP SC 825 | <b>SOFTWARE SYSTEMS FOR DATA COMMUNICATIONS</b><br>3 cr. (3 and 0) F<br>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. <b>Prerequisite:</b> CP SC 622 or permission of instructor. |
| CP SC 664 | <b>INTRODUCTION TO COMPUTER ARCHITECTURE</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                        | CP SC 828 | <b>THEORY OF PROGRAMMING LANGUAGES</b><br>3 cr. (3 and 0) F<br>Syntax and semantics of programming languages; finite state and pushdown processors; context-free models of syntax; parsing algorithms and semantic models. <b>Prerequisites:</b> CP SC 429/629 and 450/650.                                                                                                                                                                                    |
| CP SC 672 | <b>SOFTWARE DEVELOPMENT METHODOLOGY</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                             | CP SC 829 | <b>ADVANCED COMPILER TOPICS</b><br>3 cr. (3 and 0) S<br>Advanced study of code generation, register allocation, program optimization, data flow, interprocedural operations, parallel compilation and distributed compilation. <b>Prerequisites:</b> CP SC 429/629 and 450/650.                                                                                                                                                                                |
| CP SC 681 | <b>SELECTED TOPICS</b><br>1-3 cr. (1-3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                                          | CP SC 830 | <b>SYSTEMS MODELING</b><br>3 cr. (3 and 0) S (even numbered years)<br>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. <b>Prerequisites:</b> CP SC 630 and MTHSC 400 or MTHSC 800, or permission of instructor.                             |
| CP SC 740 | <b>COMPUTER SCIENCE FOR HIGH SCHOOL TEACHERS I</b><br>3 cr. (2 and 2) N<br>Introduction to modern problem-solving and programming methods for high school teachers. Topics include 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. <b>Prerequisite:</b> Introductory computer programming. | CP SC 838 | <b>ADVANCED DATA STRUCTURES</b><br>3 cr. (3 and 0) F (odd numbered years)<br>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                                                                                                                                       |
| CP SC 741 | <b>COMPUTER SCIENCE FOR HIGH SCHOOL TEACHERS II</b><br>3 cr. (2 and 2) N<br>Continuation of CP SC 740; problem-solving and programming techniques are considered in greater depth; elementary data structures are introduced. Restricted to graduate students and in-service teachers in secondary education. <b>Prerequisite:</b> CP SC 740 or equivalent.                                                                                                            |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| CP SC 805 | <b>ADVANCED MODELING TECHNIQUES IN COMPUTER GRAPHICS</b><br>3 cr. (3 and 0) S<br>In-depth treatment of advanced techniques used in the artificial rendering of natural scenes; brings students to the frontier of current practice in computer graphics; full software implementation of each technique is carried out; extensive coding is required. <b>Prerequisite:</b> CP SC 405/605.                                                                              |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| CP SC 810 | <b>INTRODUCTION TO ARTIFICIAL INTELLIGENCE</b><br>3 cr. (3 and 0) S<br>Problem solving and game playing; knowledge representation; expert systems; natural language processing; perception and learning. <b>Prerequisite:</b> Permission of instructor.                                                                                                                                                                                                                |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| CP SC 820 | <b>PARALLEL ARCHITECTURE</b><br>3 cr. (3 and 0) S<br>Parallel processing issues; vector and pipeline processors; arrays of processing elements; associative processors; data flow computers; networks of processors; survey of parallel programming languages; design and implementation of parallel algorithms; future trends. <b>Prerequisite:</b> CP SC 664.                                                                                                        |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |



such as computer graphics, artificial intelligence, picture processing and simulation. **Prerequisite:** Permission of instructor.

- CP SC 840 DESIGN AND ANALYSIS OF ALGORITHMS**  
3 cr. (3 and 0) S  
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. **Prerequisite:** MTHSC 419/619 or CP SC 650 or equivalent.
- CP SC 841 COMPUTATIONAL COMPLEXITY**  
3 cr. (3 and 0) F (even numbered years)  
Deterministic and nondeterministic polynomial-time algorithms; NP-complete problems and Cook's Theorem; techniques for establishing NP-completeness; oracle machines; polynomial-time hierarchy; polynomial space; probabilistic algorithms and complexity classes; parallel complexity; provable intractability results. **Prerequisite:** CP SC 650 or 840.
- CP SC 850 RECURSIVE FUNCTION THEORY**  
3 cr. (3 and 0) S (even numbered years)  
Turing machines; partially computable functions; r.e. sets; reducibilities; complete sets; recursion theorem; arithmetic hierarchy; Post's Theorem; priority methods; Turing degrees. **Prerequisite:** CP SC 650.
- CP SC 862 DATA BASE MANAGEMENT SYSTEM DESIGN**  
3 cr. (3 and 0) S  
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. **Prerequisite:** CP SC 462.
- CP SC 864 COMPUTER ARCHITECTURE**  
3 cr. (3 and 0) F  
Computer architecture and structures from the classical Von Neumann machines to state-of-the-art computer organizations; nonconventional architectures such as array, pipeline, associative, data flow, reduction and tree machines. **Prerequisite:** CP SC 664.
- CP SC 872 SOFTWARE SPECIFICATION AND DESIGN TECHNIQUES**  
3 cr. (3 and 0) F  
Techniques, tools, environments and formal methods for software specification and design; verification of design correctness. **Prerequisite:** CP SC 672 or equivalent.
- CP SC 873 SOFTWARE VERIFICATION, VALIDATION AND MEASUREMENT**  
3 cr. (3 and 0) S  
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. **Prerequisite:** CP SC 672 or equivalent.

- CP SC 881 SELECTED TOPICS**  
1-3 cr. (1-3 and 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. **Prerequisite:** Permission of instructor.
- CP SC 888 DIRECTED PROJECTS IN COMPUTER SCIENCE**  
1-6 cr.  
Directed individual project supervised by department faculty. Graded on a pass/fail basis.
- CP SC 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- CP SC 951 SEMINAR IN ALGORITHMS**  
1-3 cr. (1-3 and 0) N  
Advanced topics from current problems of interest in algorithms. May be repeated for credit. **Prerequisite:** Graduate status.
- CP SC 952 SEMINAR IN COMPUTER ARCHITECTURE**  
1-3 cr. (1-3 and 0) N  
Advanced topics from current problems of interest in computer architecture. May be repeated for credit. **Prerequisite:** Graduate status.
- CP SC 953 SEMINAR IN DATA BASE SYSTEMS**  
1-3 cr. (1-3 and 0) N  
Advanced topics from current problems of interest in data base systems. May be repeated for credit.
- CP SC 954 SEMINAR IN OPERATING SYSTEMS**  
1-3 cr. (1-3 and 0) N  
Advanced topics from current problems of interest in operating systems. May be repeated for credit. **Prerequisite:** Graduate status.
- CP SC 955 SEMINAR IN PROGRAMMING LANGUAGES**  
1-3 cr. (1-3 and 0) N  
Advanced topics from current problems of interest in programming languages. May be repeated for credit. **Prerequisite:** Graduate status.
- CP SC 956 SEMINAR IN PROGRAMMING PARADIGMS**  
1-3 cr. (1-3 and 0) N  
Advanced topics from current problems of interest in programming paradigms. May be repeated for credit. **Prerequisite:** Graduate status.
- CP SC 957 SEMINAR IN SOFTWARE ENGINEERING**  
1-3 cr. (1-3 and 0) N  
Advanced topics from current problems of interest in software engineering. May be repeated for credit. **Prerequisite:** Graduate status.
- CP SC 981 SEMINAR IN COMPUTER SCIENCE**  
1-3 cr. (1-3 and 0) N  
Topics of current research interest. May be repeated for credit.
- CP SC 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.



**Electrical Engineering**

Kelvin F. Poole, Chair, Department of Electrical and Computer Engineering

| Major                  | Degrees              |
|------------------------|----------------------|
| Electrical Engineering | M.Engr., M.S., Ph.D. |

For the M.S. 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 course work must be completed. The M.Engr. program has the same requirements as the M.S. thesis option, but the thesis is replaced by an engineering report.

Specially qualified candidates with a B.S. degree may apply for direct entry to the Ph.D. program. The program of study and hours required beyond the baccalaureate degree are specified by the focus area, but must be at least 66 including course work and research credit.

|                  |                                                                            |
|------------------|----------------------------------------------------------------------------|
| <b>E C E 604</b> | <b>SEMICONDUCTOR DEVICES</b><br>3 cr. (3 and 0) F                          |
| <b>E C E 606</b> | <b>INTRODUCTION TO MICROELECTRONICS PROCESSING</b><br>3 cr. (3 and 0) S    |
| <b>E C E 607</b> | <b>VLSI RELIABILITY</b><br>3 cr. (3 and 0) S                               |
| <b>E C E 610</b> | <b>MODERN CONTROL THEORY</b><br>3 cr. (3 and 0) F, S                       |
| <b>E C E 616</b> | <b>ELECTRIC POWER DISTRIBUTION SYSTEM ENGINEERING</b><br>3 cr. (3 and 0) S |
| <b>E C E 617</b> | <b>ELEMENTS OF SOFTWARE ENGINEERING</b><br>3 cr. (3 and 0) F, S            |
| <b>E C E 618</b> | <b>POWER SYSTEM ANALYSIS</b><br>3 cr. (3 and 0) F                          |
| <b>E C E 619</b> | <b>ELECTRIC MACHINERY</b><br>3 cr. (3 and 0) S                             |
| <b>E C E 622</b> | <b>OPERATIONAL AMPLIFIER CIRCUITS</b><br>3 cr. (2 and 2) S                 |
| <b>E C E 623</b> | <b>POWER SYSTEM PROTECTION</b><br>3 cr. (3 and 0) S                        |
| <b>E C E 626</b> | <b>DIGITAL COMPUTER DESIGN</b><br>3 cr. (3 and 0) F, S                     |
| <b>E C E 628</b> | <b>MODULATION AND NOISE</b><br>3 cr. (3 and 0) F                           |
| <b>E C E 629</b> | <b>ORGANIZATION OF COMPUTERS</b><br>3 cr. (3 and 0) F, S                   |
| <b>E C E 630</b> | <b>INTRODUCTION TO DIGITAL COMMUNICATIONS</b><br>3 cr. (3 and 0) S         |
| <b>E C E 631</b> | <b>DIGITAL ELECTRONICS</b><br>3 cr. (2 and 2) F, S                         |
| <b>E C E 632</b> | <b>INSTRUMENTATION</b><br>3 cr. (3 and 0) F                                |
| <b>E C E 633</b> | <b>SENSORS AND MICROCOMPUTER CONTROL FOR ROBOTS</b><br>3 cr. (1 and 4) F   |

|                               |                                                                                                                                                                                                                                                                                                           |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>E C E 634</b>              | <b>POWER ELECTRONICS</b><br>3 cr. (3 and 0) F                                                                                                                                                                                                                                                             |
| <b>E C E 636</b>              | <b>TRANSMISSION LINES AND MICROWAVE CIRCUITS</b><br>3 cr. (3 and 0) F                                                                                                                                                                                                                                     |
| <b>E C E 638</b>              | <b>COMPUTER COMMUNICATIONS</b><br>3 cr. (3 and 0) F                                                                                                                                                                                                                                                       |
| <b>E C E 639</b>              | <b>FIBER OPTICS</b><br>3 cr. (3 and 0) F                                                                                                                                                                                                                                                                  |
| <b>E C E 640</b>              | <b>PERFORMANCE ANALYSIS OF LOCAL COMPUTER NETWORKS</b><br>3 cr. (3 and 0) S                                                                                                                                                                                                                               |
| <b>E C E 642</b>              | <b>KNOWLEDGE ENGINEERING</b><br>3 cr. (3 and 0) F                                                                                                                                                                                                                                                         |
| <b>E C E 646</b>              | <b>ANTENNAS AND PROPAGATION</b><br>3 cr. (3 and 0) S                                                                                                                                                                                                                                                      |
| <b>E C E 652</b>              | <b>PROGRAMMING SYSTEMS</b><br>3 cr. (3 and 0) S                                                                                                                                                                                                                                                           |
| <b>E C E 656</b><br>(M E 656) | <b>FUNDAMENTALS OF ROBOTICS</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                        |
| <b>E C E 659</b>              | <b>INTEGRATED CIRCUIT DESIGN</b><br>3 cr. (2 and 2) F, S                                                                                                                                                                                                                                                  |
| <b>E C E 660</b>              | <b>COMPUTER-AIDED ANALYSIS AND DESIGN</b><br>3 cr. (3 and 0) F                                                                                                                                                                                                                                            |
| <b>E C E 667</b>              | <b>INTRODUCTION TO DIGITAL SIGNAL PROCESSING</b><br>3 cr. (3 and 0) F, S                                                                                                                                                                                                                                  |
| <b>E C E 668</b>              | <b>THE EMBEDDED MICROPROCESSOR</b><br>3 cr. (2 and 2) S                                                                                                                                                                                                                                                   |
| <b>E C E 692</b>              | <b>SPECIAL PROBLEMS</b><br>1-3 cr. (0 and 2)                                                                                                                                                                                                                                                              |
| <b>E C E 693</b>              | <b>SELECTED TOPICS</b><br>1-3 cr. (1-3 and 0)                                                                                                                                                                                                                                                             |
| <b>E C E 701</b>              | <b>MASTER OF ENGINEERING DESIGN PROJECT</b><br>1-6 cr. (0 and 0) F, S<br>Practical problems in engineering analysis and design, culminating in the written report required for the Master of Engineering (M.Engr.) degree. Graded on a pass/fail basis. May be repeated for up to six hours total credit. |
| <b>E C E 801</b>              | <b>ANALYSIS OF LINEAR SYSTEMS</b><br>3 cr. (3 and 0) F<br>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.                                                   |
| <b>E C E 802</b>              | <b>ELECTRIC MOTOR CONTROL</b><br>3 cr. (3 and 0)<br>Dynamic modeling and analysis of electrical machines for design of AC and DC drive systems; emphasis on implementation of such models on a digital computer; voltage-fed                                                                              |



inverters; pulse width modulation and analysis techniques for inverters; harmonic generation and reduction. **Prerequisite:** E C E 434/634.

- E C E 804 METHODS OF APPLIED OPTIMIZATION AND OPTIMUM CONTROL**  
3 cr. (3 and 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. **Corequisite:** MTHSC 653.
- E C E 805 METHODS OF STATE AND PARAMETER ESTIMATION OF STOCHASTIC SYSTEMS**  
3 cr. (3 and 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. **Corequisite:** MTHSC 654.
- E C E 807 COMPUTER METHODS FOR POWER SYSTEMS ANALYSIS**  
3 cr. (3 and 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. **Prerequisite:** E C E 418/618.
- E C E 811 INTEGRATED CIRCUIT DESIGN**  
3 cr. (2 and 2)  
Design concepts and factors influencing the choice of technology; fundamental MOS device design; silicon foundries, custom and semi-custom 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. **Prerequisite:** E C E 459/659.
- E C E 817 POWER SYSTEM TRANSIENTS**  
3 cr. (3 and 0)  
Electrical transients in power systems; frequency domain and time domain techniques for power systems transient analysis; study of capacitor switching, load switching, fault-induced transients, line reclosing and single pole switching. **Prerequisite:** Permission of instructor.
- E C E 819 DETECTION AND ESTIMATION THEORY**  
3 cr. (3 and 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. **Prerequisite:** E C E 820.

- E C E 820 DIGITAL COMMUNICATION SYSTEMS I**  
3 cr. (3 and 0)  
Modern communications systems emphasizing modulation and methods of taking into account effects of noise on various systems. **Prerequisite:** E C E 428/628 or equivalent.
- E C E 821 DIGITAL COMMUNICATION SYSTEMS II**  
3 cr. (3 and 0)  
Continuation of E C E 820.
- E C E 822 INFORMATION THEORY**  
3 cr. (3 and 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 cr. (3 and 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. **Prerequisite:** Permission of instructor.
- E C E 825 SOLID-STATE ELECTRONICS**  
3 cr. (3 and 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 830 ELECTROMAGNETICS**  
3 cr. (3 and 0)  
Vector analysis; electrostatics; electrostatic fields in material bodies; solution of boundary-value problems; stationary currents; static magnetic fields; magnetic fields in material bodies; quasi-stationary magnetic fields. **Prerequisite:** Permission of instructor.
- E C E 831 ADVANCED ELECTROMAGNETIC THEORY**  
3 cr. (3 and 0)  
Advanced boundary-value problems in cylindrical and spherical coordinates, special functions, Sommerfeld integrals, Green's functions and integral equations. **Prerequisite:** E C E 830.
- E C E 834 ASYMPTOTIC METHODS AND DIFFRACTION THEORY**  
3 cr. (3 and 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; diffraction from edges and curved surfaces is applied to scattering and antenna problems. **Prerequisites:** E C E 830.



- E C E 836 MICROWAVE CIRCUITS AND SYSTEMS**  
3 cr. (3 and 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. **Prerequisite:** E C E 436. **Corequisite:** E C E 830.
- E C E 837 ADVANCED ANTENNA THEORY**  
3 cr. (3 and 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. **Prerequisite:** E C E 446. **Corequisite:** E C E 830.
- E C E 838 SPECIAL TOPICS IN ELECTROMAGNETICS**  
1 cr. (1 and 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. **Prerequisite:** Permission of instructor.
- E C E 839 INTEGRAL EQUATIONS IN ELECTROMAGNETICS**  
3 cr. (3 and 0)  
Integral equation formulation in electromagnetics, solution techniques, moment methods and application to practical problems. **Prerequisite:** E C E 830 or permission of instructor.
- E C E 840 PHYSICS OF SEMICONDUCTOR DEVICES**  
3 cr. (3 and 0)  
Semiconductor device physics emphasized rather than circuits; detailed analysis of the p-n junction, traps, surface states and conduction processes in 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. **Prerequisites:** E C E 404 and 406/606.
- E C E 841 DISTRIBUTED COMPUTING AND NETWORKS\***  
3 cr. (3 and 0) S
- E C E 842 COMPUTER ARCHITECTURE\***  
3 cr. (3 and 0) S
- E C E 844 DIGITAL SIGNAL PROCESSING**  
3 cr. (3 and 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. **Prerequisite:** E C E 467/667.
- E C E 845 COMPUTER SYSTEM DESIGN AND OPERATION\***  
3 cr. (3 and 0)
- E C E 846 DIGITAL PROCESSING OF SPEECH SIGNALS**  
3 cr. (3 and 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. **Prerequisite:** E C E 467.
- E C E 847 DIGITAL IMAGE PROCESSING**  
3 cr. (3 and 0)  
Digital image fundamentals; comparison of image transforms, including KL, Fourier, Walsh, Hadamard, cosine and slant; image data compression techniques; image enhancement algorithms; image restoration; image encoding process; image segmentation and description. **Prerequisite:** E C E 467.
- E C E 849 ADVANCED TOPICS IN COMPUTER COMMUNICATIONS\***  
3 cr. (3 and 0)
- E C E 850 COMPUTATION AND SIMULATION\***  
3 cr. (3 and 0)
- E C E 851 ADVANCED TOPICS IN COMPUTER ARCHITECTURE\***  
3 cr. (3 and 0)
- E C E 852 SOFTWARE ENGINEERING\***  
3 cr. (3 and 0) F
- E C E 854 (M E 854) ANALYSIS OF ROBOTIC SYSTEMS**  
3 cr. (3 and 0)  
Methods of designing and operating robotics systems for advanced automation; on-line identification and description of 3D objects by digitized images; off-line collision-free path planning and on-line collision avoidance traveling using artificial intelligence. **Prerequisite:** E C E/ M E 456 or permission of instructor.
- E C E 855 ARTIFICIAL INTELLIGENCE\***  
3 cr. (3 and 0)
- E C E 856 PATTERN RECOGNITION**  
3 cr. (3 and 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 cr. (3 and 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. **Prerequisite:** E C E 822.

\* Descriptions of these courses are listed under Computer Engineering.



- E C E 859 (M E 859) INTELLIGENT ROBOTIC SYSTEMS**  
3 cr. (3 and 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. **Prerequisite:** E C E/M E 854 or permission of instructor.
- E C E 861 COMPUTER RELAYING OF POWER SYSTEMS**  
3 cr. (3 and 0)  
Principles of digital protection schemes; application to the digital protection of power system components; transmission lines, generators, motors and transformers; detection of power system frequency deviation and load shedding techniques; fault location techniques and identification of power systems disturbances. **Prerequisites:** E C E 418/618 and permission of instructor.
- E C E 862 REAL TIME COMPUTER APPLICATION IN POWER SYSTEMS**  
3 cr. (3 and 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. **Prerequisite:** E C E 418/618.
- E C E 863 POWER SYSTEM DYNAMICS AND STABILITY**  
3 cr. (3 and 0)  
Modeling of synchronous machines and their control systems; study of 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. **Prerequisites:** E C E 418/618 and 419/619.
- E C E 872 ARTIFICIAL NEURAL NETWORKS**  
3 cr. (3 and 0)  
Design, analysis and application of artificial neural networks. Topics include neuron models, network architectures, training (supervised and unsupervised) and hardware implementation; extended studies of selected applications and simulation exercises. **Prerequisites:** MTHSC 311 or permission of instructor, and graduate standing.
- E C E 890 ENGINEERING REPORT RESEARCH**  
Variable credit hours.  
Research culminating in writing an engineering report to satisfy one of the requirements for the nonthesis option for the Master of Science degree. The engineering report is similar to the thesis but requires only departmental approval. Graded on a pass/fail basis.
- E C E 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.

- E C E 892 SPECIAL PROBLEMS IN ELECTRICAL AND COMPUTER ENGINEERING**  
1-3 cr. (1-3 and 0)  
Term paper, special design or other problems in electrical and computer engineering approved by the instructor; not to be used for investigation associated with the M.S. thesis or the engineering report. May be repeated for additional credit.
- E C E 893 SELECTED TOPICS IN ELECTRICAL AND COMPUTER ENGINEERING**  
1-3 cr. (1-3 and 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 additional credit. **Prerequisite:** Permission of instructor.
- E C E 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

### Management Science

Peter R. Nelson, Program Coordinator, Department of Mathematical Sciences

| Major              | Degree |
|--------------------|--------|
| Management Science | Ph.D.  |

See the College of Professional Studies for information on this program.

### Mathematical Sciences

Robert E. Fennell, Chair, Department of Mathematical Sciences

| Major                 | Degrees     |
|-----------------------|-------------|
| Mathematical Sciences | M.S., Ph.D. |

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, a breadth requirement and a concentration area. Every student's program is required to include at least one course which emphasizes mathematical modeling. A minimum of 36 graduate 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.

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 include two courses from each of the major areas of the mathematical sciences, and generally consists of 60 hours of graduate course work. Students are admitted to candidacy for the Ph.D. degree upon successful completion of a qualifying examination in three areas. A student's Ph.D. program must include both a concentration area and a supporting area.

The departments of Management (College of Professional Studies) and Mathematical Sciences jointly offer and administer a doctoral program in management science. It is described under Management Science in the College of Professional Studies.

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

- MTHSC 600 THEORY OF PROBABILITY**  
3 cr. (3 and 0)
- MTHSC 601 STATISTICAL METHODOLOGY**  
3 cr. (3 and 0)



|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                  |                                                                                                                                                                                                                                                                                                                                                  |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>MTHSC 603</b> | <b>INTRODUCTION TO STATISTICAL THEORY</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                           |                  |                                                                                                                                                                                                                                                                                                                                                  |
| <b>MTHSC 605</b> | <b>STATISTICAL THEORY AND METHODS II</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                            | <b>MTHSC 707</b> | <b>MATHEMATICS FOR MIDDLE SCHOOL TEACHERS — ALGEBRA</b><br>3 cr. (3 and 0)<br>Algebraic concepts in middle-school mathematics: elementary number theory; the rational, real and complex number systems; polynomials and rational expressions; equations and inequalities. Restricted to graduate students in elementary and secondary education. |
| <b>MTHSC 606</b> | <b>SAMPLING THEORY AND METHODS</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                                  |                  |                                                                                                                                                                                                                                                                                                                                                  |
| <b>MTHSC 607</b> | <b>REGRESSION AND TIME SERIES ANALYSIS</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                          | <b>MTHSC 709</b> | <b>MATHEMATICS FOR MIDDLE SCHOOL TEACHERS — GEOMETRY</b><br>3 cr. (3 and 0)<br>Geometric concepts in middle-school mathematics: lines and planes, angles and triangles, congruence and similarity, circles and spheres, area and volume. Restricted to graduate students in elementary and secondary education.                                  |
| <b>MTHSC 608</b> | <b>TOPICS IN GEOMETRY</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                                           |                  |                                                                                                                                                                                                                                                                                                                                                  |
| <b>MTHSC 612</b> | <b>INTRODUCTION TO MODERN ALGEBRA</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                               | <b>MTHSC 710</b> | <b>ELEMENTARY CALCULUS FROM AN ADVANCED VIEWPOINT I</b><br>3 cr. (3 and 0)<br>Origins of calculus; limits; derivative; maxima and minima; continuity; area and other applications of the integral. Restricted to graduate students in elementary and secondary education. <b>Prerequisite:</b> MTHSC 108 or its equivalent.                      |
| <b>MTHSC 619</b> | <b>DISCRETE MATHEMATICAL STRUCTURES</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                             |                  |                                                                                                                                                                                                                                                                                                                                                  |
| <b>MTHSC 634</b> | <b>ADVANCED ENGINEERING MATHEMATICS</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                             | <b>MTHSC 711</b> | <b>ELEMENTARY CALCULUS FROM AN ADVANCED VIEWPOINT II</b><br>3 cr. (3 and 0)<br>Techniques of integration, logarithmic and exponent functions; applications of integrals; sequences and series. Restricted to graduate students in elementary and secondary education. <b>Prerequisite:</b> MTHSC 710 or permission of instructor.                |
| <b>MTHSC 635</b> | <b>COMPLEX VARIABLES</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                                            |                  |                                                                                                                                                                                                                                                                                                                                                  |
| <b>MTHSC 640</b> | <b>LINEAR PROGRAMMING</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>MTHSC 712</b> | <b>MODERN ALGEBRAIC CONCEPTS</b><br>3 cr. (3 and 0)<br>Development of axioms and fundamental concepts of some modern algebraic structures such as groups, rings and fields; applications to the familiar number systems. Restricted to graduate students in secondary education.                                                                 |
| <b>MTHSC 641</b> | <b>INTRODUCTION TO STOCHASTIC MODELS</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                            |                  |                                                                                                                                                                                                                                                                                                                                                  |
| <b>MTHSC 653</b> | <b>ADVANCED CALCULUS I</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>MTHSC 719</b> | <b>DISCRETE MATHEMATICS</b><br>3 cr. (3 and 0)<br>A survey of 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.                                                                |
| <b>MTHSC 654</b> | <b>ADVANCED CALCULUS II</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                                         |                  |                                                                                                                                                                                                                                                                                                                                                  |
| <b>MTHSC 660</b> | <b>INTRODUCTION TO NUMERICAL ANALYSIS</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                           | <b>MTHSC 721</b> | <b>MATRIX ALGEBRA</b><br>3 cr. (3 and 0)<br>Matrices and systems of equations; determinants; vector spaces and linear transformations; eigenvalues. Restricted to graduate students in secondary education.                                                                                                                                      |
| <b>MTHSC 663</b> | <b>MATHEMATICAL ANALYSIS I</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                                      |                  |                                                                                                                                                                                                                                                                                                                                                  |
| <b>MTHSC 664</b> | <b>MATHEMATICAL ANALYSIS II</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>MTHSC 723</b> | <b>APPLICATIONS OF LINEAR AND MODERN ALGEBRA</b><br>3 cr. (3 and 0)<br>Various applied problems whose solutions rely on techniques and results of linear and modern algebra; problems selected from such areas as                                                                                                                                |
| <b>MTHSC 700</b> | <b>MATHEMATICAL COMPUTER APPLICATIONS FOR ELEMENTARY TEACHERS</b><br>3 cr. (3 and 0)<br>Use of readily available software as tools in the elementary mathematics curriculum; LOGO language is used in a discovery approach to geometry; spreadsheets are employed to facilitate the organization and statistical processing of classroom data; word processing is integrated with spreadsheets applied to mathematics problem sets, examinations and parental reports. |                  |                                                                                                                                                                                                                                                                                                                                                  |
| <b>MTHSC 703</b> | <b>MODERN MATHEMATICS FOR ELEMENTARY SCHOOL TEACHERS — GEOMETRY</b><br>3 cr. (3 and 0)<br>Concepts of geometry; informal geometry; measurement of geometric figures; metric measurements; deductive geometry; functions in geometry; coordinate and vector geometry. Restricted                                                                                                                                                                                        |                  |                                                                                                                                                                                                                                                                                                                                                  |



economics, forest management, genetics, population growth, transportation networks, cryptography, satellite communications, electronic switching circuits, chemistry, physics, sociology and others. **Prerequisite:** MTHSC 712, MTHSC 721 or equivalent, or permission of instructor.

- MTHSC 725 COMBINATORIAL MATHEMATICS FOR TEACHERS**  
3 cr. (3 and 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. Restricted to graduate students in secondary education.
- MTHSC 727 ANALYSIS CONCEPTS FOR TEACHERS**  
3 cr. (3 and 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 730 MODERN GEOMETRY FOR TEACHERS**  
3 cr. (3 and 0)  
Concepts of Euclidean geometry reviewed and extended by means of coordinates, vectors, matrices; conic sections. Restricted to graduate students in secondary education.
- MTHSC 732 PROJECTIVE GEOMETRY**  
3 cr. (3 and 0)  
Analytic and synthetic development of properties of projective geometry and its subgeometries, ranging from affine to Euclidean geometry. Restricted to graduate students in secondary education.
- MTHSC 741 INTRODUCTION TO LINEAR PROGRAMMING WITH APPLICATIONS**  
3 cr. (3 and 0)  
Development of mathematical theory of simplex algorithm; survey of mathematical background; matrix algebra, systems of linear equations and vector spaces; problem formulation emphasized. Restricted to graduate students in secondary education.
- MTHSC 751 FUNDAMENTAL CONCEPTS OF CALCULUS**  
3 cr. (3 and 0)  
Set theory; real number system; functions and relations; metric sets and limits; continuity and differentiation; integration. Restricted to graduate students in secondary education. **Prerequisite:** One year of undergraduate calculus.
- MTHSC 761 PROBABILITY AND STATISTICS FOR TEACHERS**  
3 cr. (3 and 0)  
Probability; conditional probability; descriptive statistics; random variables; probability functions; binomial distribution; normal distribution; sampling; estimation; decision making.

Restricted to graduate students in secondary education.

- MTHSC 771 NUMERICAL METHODS IN SECONDARY SCHOOL MATHEMATICS**  
3 cr. (3 and 0)  
Update of traditional techniques for teaching high school mathematics through introduction of computer methods for investigation of processes and reinforcement of concepts; development of programs requiring participants to "invent" algorithms to solve problems in the typical high school mathematics course; use of general purpose programming language; methods of teaching this language to high school students. Restricted to graduate students in secondary education.
- MTHSC 783 THEORY OF NUMBERS**  
3 cr. (3 and 0)  
Properties of integers, divisors and prime numbers; fundamental properties of congruence; polynomial and primitive roots; quadratic residues. Restricted to graduate students in secondary education.
- MTHSC 791 SELECTED TOPICS IN MATHEMATICS EDUCATION**  
1-3 cr. (1-3 and 0)  
Mathematical problems in curriculum of elementary or secondary school. Restricted to graduate students in elementary or secondary education. May be repeated for credit, but only if different topics are covered.
- MTHSC 800 PROBABILITY**  
3 cr. (3 and 0) F  
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. **Prerequisite:** MTHSC 206.
- MTHSC 801 GENERAL LINEAR HYPOTHESIS I**  
3 cr. (3 and 0) F  
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. **Prerequisites:** MTHSC 403/603 and 311.
- MTHSC 802 GENERAL LINEAR HYPOTHESIS II**  
3 cr. (3 and 0) S  
Continuation of MTHSC 801.
- MTHSC 803 STOCHASTIC PROCESSES**  
3 cr. (3 and 0) S, SS  
Theory and analysis of time series; recurrent events; Markov chains; random walks; renewal theory; application to communication theory; operations research. **Prerequisite:** MTHSC 400/600 or 800.



- MTHSC 805 DATA ANALYSIS**  
3 cr. (3 and 0) F, S  
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. **Prerequisites:** MTHSC 301 and 400/600, or MTHSC 401/601 and 800.
- MTHSC 806 NONPARAMETRIC STATISTICS**  
3 cr. (3 and 0) F  
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. **Prerequisite:** MTHSC 600 or 800.
- MTHSC 807 APPLIED MULTIVARIATE ANALYSIS**  
3 cr. (3 and 0) F  
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; principle components analysis; factor analysis; analytic rotations; canonical correlations. **Prerequisites:** MTHSC 403/603 and 805 or permission of instructor.
- MTHSC 808 RELIABILITY AND LIFE TESTING**  
3 cr. (3 and 0) S  
Probability models and statistical methods relevant to parametric and nonparametric analysis of reliability and life testing data. **Prerequisites:** MTHSC 400/600 and 401/601 or equivalent.
- MTHSC 809 TIME SERIES ANALYSIS, FORECASTING AND CONTROL**  
3 cr. (3 and 0) F  
Modeling and forecasting random processes; autocorrelation functions and spectral densities; model identification, estimation and diagnostic checking; transfer function models; feedforward and feedback control schemes. **Prerequisites:** MTHSC 600 and 605, or MTHSC 800 and 605, or equivalent.
- MTHSC 810 MATHEMATICAL PROGRAMMING**  
3 cr. (3 and 0) F, S  
Formulation and solution of linear programming models; mathematical development of the simplex method; revised simplex method; duality; sensitivity analysis; parametric programming, implementation, software packages. **Prerequisite:** MTHSC 311.
- MTHSC 811 NONLINEAR PROGRAMMING**  
3 cr. (3 and 0) S  
Theoretical development of nonlinear optimization with applications; classical optimization; convex and concave functions; separable programming; quadratic programming; gradient methods. **Prerequisites:** MTHSC 440 and 454.
- MTHSC 812 DISCRETE OPTIMIZATION**  
3 cr. (3 and 0) F  
Principal methods used in integer programming and discrete optimization. Topics include 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. **Prerequisite:** MTHSC 810 or equivalent.
- MTHSC 813 ADVANCED LINEAR PROGRAMMING**  
3 cr. (3 and 0) S  
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. **Prerequisite:** MTHSC 440/640, 810 or equivalent.
- MTHSC 814 NETWORK FLOW PROGRAMMING**  
3 cr. (3 and 0) F  
Max-flow/min-cut theorem; combinatorial applications; minimum cost flow problems (transportation, shortest path, transshipment); solution algorithms (including the out-of-kilter); implementation and computational considerations. **Prerequisite:** MTHSC 440/640, 810 or equivalent.
- MTHSC 816 NETWORK ALGORITHMS AND DATA STRUCTURES**  
3 cr. (3 and 0) F  
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. **Corequisite:** MTHSC 640, 810, 854, 863 or permission of instructor.
- MTHSC 817 STOCHASTIC MODELS IN OPERATIONS RESEARCH I**  
3 cr. (3 and 0) F  
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. **Prerequisite:** MTHSC 803.
- MTHSC 818 STOCHASTIC MODELS IN OPERATIONS RESEARCH II**  
3 cr. (3 and 0) S  
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. **Prerequisite:** MTHSC 817.

- MTHSC 819 MULTICRITERIA OPTIMIZATION**  
3 cr. (3 and 0) S  
Theory and methodology of optimization problems with vector-valued objective functions; preference orders and domination structures; generating "efficient" solutions; solving multi-criteria decision-making problems, noninteractive and interactive methods with applications. **Prerequisite:** MTHSC 810 or equivalent.
- MTHSC 820 COMPLEMENTARITY MODELS**  
3 cr. (3 and 0) S  
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. **Prerequisite:** MTHSC 810.
- MTHSC 821 LINEAR ANALYSIS**  
3 cr. (3 and 0) S, SS  
Normed spaces, Hilbert spaces, Banach spaces, linear functionals, linear operators, orthogonal systems. **Prerequisites:** MTHSC 454/654 or MTHSC 453 and 853.
- MTHSC 822 MEASURE AND INTEGRATION**  
3 cr. (3 and 0) F  
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. **Prerequisite:** MTHSC 454/654.
- MTHSC 823 COMPLEX ANALYSIS**  
3 cr. (3 and 0)  
Topological concepts; complex integration; local and global properties of analytic functions; power series; representation theorems; calculus of residues. Designed for nonengineering majors. **Prerequisite:** MTHSC 464/664.
- MTHSC 825 INTRODUCTION TO DYNAMICAL SYSTEMS THEORY**  
3 cr. (3 and 0) F  
Techniques of analysis of dynamical systems. Topics include sensitivity analysis, linear systems, stability and control; the theory of differential and difference equations is emphasized. **Prerequisites:** MTHSC 454/654 and 311, or MTHSC 453 and 853.
- MTHSC 826 PARTIAL DIFFERENTIAL EQUATIONS**  
3 cr. (3 and 0) F  
First-order equations: elliptic, hyperbolic and parabolic; second-order equations: existence and uniqueness results, maximum principles, finite difference and Hilbert Space methods.

**Prerequisite:** MTHSC 821 or permission of instructor.

- MTHSC 827 DYNAMICAL SYSTEM NEURAL NETWORKS**  
3 cr. (3 and 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. **Prerequisites:** MTHSC 206 and MTHSC 311.
- MTHSC 831 FOURIER SERIES**  
3 cr. (3 and 0) SS  
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. **Prerequisite:** MTHSC 464/664.
- MTHSC 837 CALCULUS OF VARIATIONS AND OPTIMAL CONTROL**  
3 cr. (3 and 0) SS  
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. **Prerequisite:** MTHSC 453/653 or 463/663.
- MTHSC 841 APPLIED MATHEMATICS I**  
3 cr. (3 and 0) F  
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. **Prerequisites:** MTHSC 208 and 453/653 or MTHSC 463/663.
- MTHSC 842 APPLIED MATHEMATICS II**  
3 cr. (3 and 0)  
Continuation of MTHSC 841.
- MTHSC 851 ABSTRACT ALGEBRA I**  
3 cr. (3 and 0) S  
Survey of some basic algebraic structures: groups, rings and fields. Topics include permutation groups, Sylow theorems, finite abelian groups, polynomial domains, factorization theory and elementary field theory.
- MTHSC 852 ABSTRACT ALGEBRA II**  
3 cr. (3 and 0) F  
A continuation of MTHSC 851 including selected topics from ring theory and field theory.
- MTHSC 853 MATRIX ANALYSIS**  
3 cr. (3 and 0) F, S  
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. **Prerequisite:** MTHSC 311, 453 or 463.



- MTHSC 854 THEORY OF GRAPHS**  
3 cr. (3 and 0) S  
Connectedness; path problems; trees; matching theorems; directed graphs; fundamental numbers of the theory of graphs; groups and graphs. **Prerequisite:** Permission of instructor.
- MTHSC 855 COMBINATORIAL ANALYSIS**  
3 cr. (3 and 0) F  
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. **Prerequisite:** MTHSC 311.
- MTHSC 856 APPLICABLE ALGEBRA**  
3 cr. (3 and 0) S  
Applied algebraic ideas in lattice theory and Boolean Algebra; finite-state sequential machines; group theory as applied to network complexity and combinatorial enumeration; algebraic coding theory. Topics vary with background and interests of students. **Prerequisites:** MTHSC 851 and 853 or permission of instructor.
- MTHSC 860 AN INTRODUCTION TO SCIENTIFIC COMPUTING**  
3 cr. (3 and 0) S, SS  
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. **Prerequisite:** MTHSC 208, 311 and CP SC 110.
- MTHSC 861 ADVANCED NUMERICAL ANALYSIS I**  
3 cr. (3 and 0) F  
Interpolation and approximation; numerical quadrature; numerical solution of functional differential equations; integral equations and overdetermined linear systems; eigenvalue problems; approximation using splines. **Prerequisites:** MTHSC 453 and 460.
- MTHSC 862 ADVANCED NUMERICAL ANALYSIS II**  
3 cr. (3 and 0) S  
Continuation of MTHSC 861.
- MTHSC 863 DIGITAL MODELS I**  
3 cr. (3 and 0) F  
Experimental mathematics; pseudo-stochastic 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. **Prerequisites:** MTHSC 311, 453/653 and digital computer experience.
- MTHSC 864 DIGITAL MODELS II**  
3 cr. (3 and 0)  
Continuation of MTHSC 863.
- MTHSC 865 DATA STRUCTURES**  
3 cr. (3 and 0) F  
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. **Prerequisites:** Computational maturity and permission of instructor.
- MTHSC 881 MATHEMATICAL STATISTICS**  
3 cr. (3 and 0) S  
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. **Prerequisite:** MTHSC 403/603 or equivalent.
- MTHSC 882 MONTE CARLO METHODS**  
3 cr. (3 and 0) F  
Random number generators, discrete and continuous random variate generation and approximations, random vector generation, Monte Carlo integration, variance reduction techniques. **Prerequisites:** MTHSC 800 and 603.
- MTHSC 885 ADVANCED DATA ANALYSIS**  
3 cr. (3 and 0) F  
Continuation of MTHSC 805, covering alternatives to ordinary least squares, influence and diagnostic considerations, robustness, special statistical computation methods. **Prerequisites:** MTHSC 800, 603 and 805.
- MTHSC 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged. F, S, SS
- MTHSC 892 MASTER'S PROJECT COURSE**  
1 cr. (0 and 1) F, S, SS  
For students in the nonthesis option of the Master of Science degree program in the 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 cr. (3 and 0) N  
Examination of many of the elements involved in being a college professor with special emphasis on broadening the student's mathematical experiences within a framework of improving classroom performance. **Prerequisite:** Completion of the departmental Ph.D. qualifying examinations.
- MTHSC 901 PROBABILITY THEORY I**  
3 cr. (3 and 0) N  
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. **Prerequisites:** MTHSC 400/600 and



822, or MTHSC 800 and 822, or permission of instructor.

- MTHSC 902 PROBABILITY THEORY II**  
3 cr. (3 and 0) N  
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. **Prerequisite:** MTHSC 901.
- MTHSC 907 MULTIVARIATE ANALYSIS**  
3 cr. (3 and 0) N  
Multivariate normal distribution; Wishart distribution; Hotellings  $T^2$  distribution; estimation of parameters; test of hypotheses on vector means and covariance matrices. **Prerequisite:** MTHSC 802.
- MTHSC 927 FUNCTIONAL ANALYSIS**  
3 cr. (3 and 0) N  
Linear operators on specific spaces, spectral theory, semigroups of operators and the Hille-Yosida theorem, applications of linear spaces and operators, convexity. **Prerequisite:** MTHSC 821.
- MTHSC 954 ADVANCED GRAPH THEORY**  
3 cr. (3 and 0) F  
Continuation of MTHSC 854; topics not covered in 854, including the four-color theorem, domination numbers, Ramsey theory, graph isomorphism, embeddings, algebraic graph theory and tournaments; research papers are also examined. **Prerequisite:** MTHSC 854 or permission of instructor.
- MTHSC 981 SELECTED TOPICS IN MATHEMATICAL STATISTICS AND PROBABILITY**  
1-3 cr. (1-3 and 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 cr. (1-3 and 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 cr. (1-3 and 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 cr. (1-3 and 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 cr. (1-3 and 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 cr. (1-3 and 0)  
Advanced topics in operations research from current problems of interest. May be repeated for credit, but only if different topics are covered.
- MTHSC 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

## Physics

Peter J. McNulty, Chair, Department of Physics and Astronomy

**Major**  
Physics

**Degrees**  
M.S., Ph.D.

Graduate studies in physics and astronomy may be pursued by well-prepared students in the physical and mathematical sciences or engineering.

Students beginning graduate studies in physics and astronomy usually enter the M.S. program. After two semesters, well-prepared students will be ready to begin a research program. This program most often 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. A written report must be submitted. A final oral examination on the general area and directed activities completes the requirements for the nonthesis option. A program leading to the M.S. degree in physics with a concentration in health physics is available. Courses in health physics or biophysics, biology, biochemistry or chemistry are required in this option.

Study for the Ph.D. 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 receiving the Ph.D. degree, a final oral examination on the dissertation must be completed.

- PHYS 617 INTRODUCTION TO BIOPHYSICS**  
3 cr. (3 and 0)
- PHYS 620 ATMOSPHERIC PHYSICS**  
3 cr. (3 and 0)
- PHYS 621 MECHANICS I**  
3 cr. (3 and 0)
- PHYS 622 MECHANICS II**  
3 cr. (3 and 0)
- PHYS 625 EXPERIMENTAL PHYSICS I**  
3 cr. (1 and 4)
- PHYS 626 EXPERIMENTAL PHYSICS II**  
3 cr. (1 and 4)
- PHYS 632 OPTICS**  
3 cr. (3 and 0)
- PHYS 641 ELECTROMAGNETICS I**  
3 cr. (3 and 0)



- PHYS 642 ELECTROMAGNETICS II**  
3 cr. (3 and 0)
- PHYS 646 SOLID STATE PHYSICS**  
3 cr. (3 and 0)
- PHYS 652 NUCLEAR AND PARTICLE PHYSICS**  
3 cr. (3 and 0)
- PHYS 655 QUANTUM PHYSICS I**  
3 cr. (3 and 0)
- PHYS 656 QUANTUM PHYSICS II**  
3 cr. (3 and 0)
- PHYS 665 THERMODYNAMICS AND STATISTICAL MECHANICS**  
3 cr. (3 and 0)
- PHYS 675 SELECTED TOPICS**  
1-3 cr. (0-3 and 0-9)
- PHYS 710 SELECTED TOPICS FOR TEACHERS**  
1-6 cr. (0-6 and 0-18)  
One or more topics are discussed; 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.  
**Prerequisite:** Permission of instructor.
- PHYS 811 METHODS OF THEORETICAL PHYSICS I**  
3 cr. (3 and 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 cr. (3 and 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 815 (M E 815) STATISTICAL THERMODYNAMICS I**  
3 cr. (3 and 0)  
Fundamental principles of kinetic theory and quantum statistical mechanics; Boltzmann statistics, Fermi-Dirac statistics and Bose-Einstein statistics. **Prerequisite:** A course in thermodynamics or permission of instructor.
- PHYS 816 STATISTICAL THERMODYNAMICS II**  
3 cr. (3 and 0)  
Generalized ensemble theory and fluctuations; applications to solids, liquids, gases and blackbody radiation. **Prerequisite:** PHYS 815.
- PHYS 821 CLASSICAL MECHANICS I**  
3 cr. (3 and 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 cr. (3 and 0)  
Special relativity in classical mechanics; Hamilton's equations; canonical transformations; Hamilton-Jacobi theory; small oscillations.
- PHYS 841 ELECTRODYNAMICS I**  
3 cr. (3 and 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 cr. (3 and 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 cr. (3 and 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 ferro-electrics.
- PHYS 846 SOLID STATE PHYSICS II**  
3 cr. (3 and 0)  
Continuation of PHYS 845: electronic properties of solids, band theory of solids, physics of semiconductors, theories of magnetism and magnetic resonance phenomena.
- PHYS 852 RADIATION PHYSICS**  
3 cr. (3 and 0)  
The interactions and basic mechanisms involved in the natural radiation environments of space, which include a variety of energetic, charged particles with sufficient energy to penetrate heavily shielded spacecraft and pose potential hazards to astronauts and electronic systems.  
**Prerequisite:** Undergraduate degree in physics or electrical engineering or permission of instructor.
- PHYS 875 SELECTED TOPICS**  
1-3 cr. (1-3 and 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 cr.  
Training and work on practical problems; activities 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. Graded on a pass/fail basis.



- PHYS 891**      **MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- PHYS 951**      **QUANTUM MECHANICS I**  
3 cr. (3 and 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 cr. (3 and 0)  
Continuation of PHYS 951; time-dependent perturbations, radiation, absorption and emission, relativistic quantum mechanics, introduction to quantum electrodynamics.
- PHYS 966**      **RELATIVITY**  
3 cr. (3 and 0)  
Special and general theory of relativity including tensor calculus, Lorentz transformation and three experimental tests of general theory: (1) planetary motion and advance of perihelion of Mercury, (2) bending of light rays in gravitational fields and (3) gravitational shift of spectral lines.
- PHYS 971**      **ADVANCED QUANTUM THEORY I**  
3 cr. (3 and 0)  
Development of quantum theory as encountered in systems with an infinite number of degrees of freedom and in systems where relativistic effects are important; advanced scattering theory; quantization of relativistic field theories; development of covariant forms of perturbation theory. **Prerequisite:** PHYS 951 or permission of instructor.
- PHYS 991**      **DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

#### *Astronomy*

Students may specialize in astronomy or astrophysics, although their M.S. or Ph.D. degree is awarded in physics.

- ASTR 675**      **SELECTED TOPICS IN ASTROPHYSICS**  
1-3 cr. (0-3 and 0-9)
- ASTR 802**      **STELLAR STRUCTURE AND EVOLUTION**  
3 cr. (3 and 0)  
Physical principles governing the structure, power, luminosity and evolution of stars. Topics include equation of state, equations for pressure and thermal balance, heat transport, thermonuclear power and numerical techniques of structure calculation. **Prerequisite:** PHYS 455 or equivalent or permission of instructor.
- ASTR 803**      **GALACTIC STRUCTURE**  
3 cr. (3 and 0)  
Kinematics, dynamics and content of the Milky Way galaxy. Topics include galactic rotation, galactic distance scale, stellar populations, spiral structure, the galactic center, and the evolution of the Milky Way and other galaxies. **Prerequisite:** Permission of instructor.

- ASTR 805**      **NUCLEAR ASTROPHYSICS**  
3 cr. (3 and 0)  
Nuclear science applied to problems in astronomy. Topics include nuclear structure, fusion reactions, weak and electromagnetic reactions, nuclear burning in stars and resulting abundances of nuclides. **Prerequisite:** PHYS 455 or equivalent or permission of instructor.
- ASTR 875**      **SELECTED TOPICS**  
1-3 cr. (1-3 and 0)  
Study of one or more advanced topics in contemporary astrophysics. May be repeated for credit, but only if different topics are covered. **Prerequisite:** Permission of instructor.



Accountancy and Legal Studies 94  
Administration and Supervision 105  
Applied Economics 95  
Applied Sociology 120  
Business Administration 95  
Counseling and Guidance Services 105  
Curriculum and Instruction 105  
Economics 99  
Educational Leadership 113  
Elementary Education 105  
Finance 101  
Health Administration 127  
Human Resource Development 116

Industrial Education 117  
Industrial Management 101  
Management Science 104  
Marketing 105  
Nursing 121  
Psychology 126  
Public Administration 124  
Public Health 127  
Reading 105  
Secondary Education 105  
Special Education 105  
Vocational/Technical Education 119





## COLLEGE OF PROFESSIONAL STUDIES

Jerry E. Trapnell, Dean

The College of Professional Studies offers advanced degrees in these areas of study.

Accounting  
Administration and Supervision  
Applied Economics\*  
Applied Sociology  
Business Administration  
Counseling and Guidance Services  
Curriculum and Instruction  
Economics  
Educational Leadership  
Elementary Education  
Health Administration  
Human Resource Development  
Industrial Education  
Industrial Management  
Management Science\*\*  
Nursing  
Psychology  
Public Administration  
Reading  
Secondary Education  
Special Education  
Vocational/Technical Education

Courses are offered in coaching education, finance, graphic communication, health, hospital administration, law, marketing and political science to provide electives for students in other areas.

### School of Business

School of Accountancy and Legal Studies  
Applied Economics  
Business Administration  
Economics  
Finance  
Industrial Management  
Management Science  
Marketing

### School of Accountancy and Legal Studies

Alan J. Winters, Director, School of Accountancy and Legal Studies

| Major      | Degree   |
|------------|----------|
| Accounting | M.P.Acc. |

The Master of Professional Accountancy degree program is open to students with appropriate backgrounds. 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 may be considered also. Applicants should have completed a basic business core of at least

30 semester hours. An undergraduate microcomputer applications course is strongly recommended.

The graduate program requires 33 semester hours. The program accommodates both full- and part-time students.

In addition to the on-campus program, the program is offered to part-time students at the University Center in Greenville, S.C. Full-time students are able to complete the program in one calendar year. Part-time students on campus or in Greenville can complete the program in three years.

|          |                                        |
|----------|----------------------------------------|
| ACCT 604 | INDIVIDUAL TAXATION<br>3 cr. (3 and 0) |
|----------|----------------------------------------|

|          |                                                                                                                                                                                                                                                       |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ACCT 801 | CONTEMPORARY FINANCIAL ACCOUNTING THEORY<br>3 cr. (3 and 0)<br>Development of accounting theory from its origin to the present; currently advocated pronouncements of professional accounting societies. <b>Prerequisite:</b> ACCT 302 or equivalent. |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|          |                                                                                                                                                                                                                                                            |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ACCT 802 | AUDITING SEMINAR<br>3 cr. (3 and 0)<br>In-depth study of the Professional Standard for independent auditors; taught by the case method and includes a discussion of contemporary auditing problems and cases. <b>Prerequisite:</b> ACCT 415 or equivalent. |
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| ACCT 803 | ACCOUNTING INFORMATION SYSTEMS<br>3 cr. (3 and 0)<br>Accounting systems including database concepts, systems design and evaluation, systems controls and systems implementation. <b>Prerequisites:</b> ACCT 302 and 303 or equivalent. |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|          |                                                                                                                                                                                                           |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ACCT 804 | THE ENVIRONMENT OF ACCOUNTING<br>3 cr. (3 and 0)<br>Professional, legislative, judicial and social environments in which the accounting profession operates. <b>Prerequisite:</b> ACCT 415 or equivalent. |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

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|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ACCT 806 | ADVANCED ACCOUNTING PROBLEMS<br>3 cr. (3 and 0)<br>Specialized aspects of financial accounting including business combinations accounting and reporting practices of regulated and non-regulated industries, emerging practices and developments in financial accounting, fund accounting, and corporate reorganizations and liquidations. <b>Prerequisite:</b> ACCT 302 or equivalent. |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

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|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ACCT 807 | ADVANCED AUDITING TECHNIQUES<br>3 cr. (3 and 0)<br>Auditing and control techniques in an EDP environment, including statistical sampling techniques used by auditors and the auditor's use of microcomputers. <b>Prerequisite:</b> ACCT 415 or equivalent. |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|          |                                                                                                                                                                                                                |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ACCT 814 | TAXATION OF BUSINESS ENTITIES<br>3 cr. (3 and 0)<br>The interrelationship of taxation and business decisions; designed for students not specializing in taxation. <b>Prerequisite:</b> ACCT 404 or equivalent. |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

\* This program is a cooperative effort between the Department of Agricultural and Applied Economics (College of Agriculture, Forestry and Life Sciences) and the Department of Economics. The Department of Agricultural and Applied Economics is responsible administratively for the Ph.D. program, and the degree is awarded by the College of Agriculture, Forestry and Life Sciences.

\*\* This program is administered jointly by the Department of Management and the Department of Mathematical Sciences (College of Engineering and Science). The Ph.D. degree is awarded by the College of Professional Studies.



- ACCT 815** **FEDERAL AND STATE INCOME TAXATION OF CORPORATIONS**  
3 cr. (3 and 0)  
Tax principles and concepts involved in corporate-shareholder transactions, tax planning of corporations, Subchapter C and related provisions of the Internal Revenue Code. **Prerequisite:** ACCT 404 or equivalent.
- ACCT 816** **TAXATION OF ESTATES, GIFTS AND FIDUCIARIES**  
3 cr. (3 and 0)  
Federal estate and gift tax laws; federal income tax laws related to trusts and estates. **Prerequisite:** ACCT 404 or equivalent.
- ACCT 817** **TAX RESEARCH**  
3 cr. (3 and 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. **Prerequisite:** ACCT 404 or equivalent.
- ACCT 818** **TAXATION OF PARTNERSHIPS**  
3 cr. (3 and 0)  
Tax principles and concepts involved in partnership transactions, tax planning and tax shelters. **Prerequisite:** ACCT 404 or equivalent.
- ACCT 819** **CURRENT AND SPECIAL TOPICS IN TAXATION**  
3 cr. (3 and 0)  
Specialized and contemporary topics in federal taxation and tax practice. **Prerequisite:** ACCT 404 or equivalent.
- ACCT 820** **ADVANCED TOPICS AND PLANNING IN TAXATION**  
3 cr. (3 and 0)  
Planning element for federal and state taxes in business decisions, including current, sophisticated developments in taxation. **Prerequisite:** ACCT 819 or permission of instructor.
- ACCT 821** **CONTROLLERSHIP**  
3 cr. (3 and 0)  
Advanced internal accounting emphasizing accounting implications for management decision making. **Prerequisite:** ACCT 303 or equivalent.
- ACCT 824** **ADVANCED MANAGERIAL ACCOUNTING**  
3 cr. (3 and 0)  
Current developments in cost and managerial accounting, emphasizing theories, applications, analysis and the behavioral impact of internal accounting data; completion of a field project required. **Prerequisite:** ACCT 410 or permission of instructor.
- ACCT 830** **GOVERNMENTAL AND NOT-FOR-PROFIT ACCOUNTING**  
3 cr. (3 and 0)  
Fund accounting and financial reporting for governments and other not-for-profit organizations; examines managerial control issues in the not-for-profit environments. **Prerequisites:** ACCT 202 or 203 and permission of instructor.

- ACCT 840** **INTERNAL AUDITING SEMINAR**  
3 cr. (3 and 0)  
Advanced topics in internal auditing theory and practice, using case studies and readings. **Prerequisite:** ACCT 340 or 415 or equivalent.
- ACCT 845** **OPERATIONAL AUDITING SEMINAR**  
3 cr. (3 and 0)  
Management control and operational systems, opportunities for improvement and development of practical and cost effective solutions to managerial problems using selected readings from case studies and industry monographs provided by the Institute of Internal Auditing. **Prerequisite:** ACCT 340 or 415 or permission of instructor.
- LAW 605** **CONSTRUCTION LAW**  
3 cr. (3 and 0)
- LAW 629** **ENVIRONMENTAL LAW AND POLICY**  
3 cr. (3 and 0)
- LAW 699** **SELECTED TOPICS**  
1-3 cr. (1-3 and 0)

### Applied Economics

Garnett L. Bradford, Chair, Department of Agricultural and Applied Economics

| Major             | Degree |
|-------------------|--------|
| Applied Economics | Ph.D.  |

See the College of Agriculture, Forestry and Life Sciences for information on this program.

### Business Administration

Dudley W. Blair, Program Director\*

| Major                   | Degree |
|-------------------------|--------|
| Business Administration | M.B.A. |

Requirements for the full-time M.B.A. program include 60 semester hours of graduate credit, with two prerequisite courses required of all students: calculus and a basic computer science or computer applications class. The full-time program includes an option for taking classes during one summer in Italy. Requirements for the evening M.B.A. program include as many as 33 hours of prerequisite courses depending upon academic background, and 30 semester hours of graduate credit.

Classes in the M.B.A. program are offered on the Clemson University campus as a full-time day program, while classes in the evening M.B.A. program are offered on the campuses of Furman University in Greenville, S.C., and Lander University in Greenwood, S.C., as part-time evening programs. The Clemson campus program is available only for fall entrance and is a full-time only, two-year program requiring all students to follow the same course sequence. The evening M.B.A. programs in Greenville and Greenwood are part-time programs only and require a minimum of two years of work experience beyond the bachelor's degree. In addition to the domestic programs, both

\* Correspondence for the evening program on the Furman University campus should be addressed to Director, Clemson M.B.A. Program, Furman University, 119 Furman Hall, Greenville, S.C. 29613; or call (803) 294-2090. Correspondence for the daytime program on the Clemson campus as well as for classes at Lander University should be addressed to Director, Clemson M.B.A. Program, College of Professional Studies, Clemson University, 124 Sistine Hall, Clemson, S.C. 29634; or call (803) 656-3975. Information on the classes at Lander University can be obtained by calling (803) 229-8787.



full-time and executive degree programs are offered in Pordenone, Italy, and in Ljubljana, Slovenia, in cooperation with the Consortium of Universities for International Business Studies.

- M B A 802      MANAGERIAL ECONOMICS**  
3 cr. (3 and 0)  
Intensive study of the functioning of the market economy with emphasis on 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. **Prerequisites:** Economic principles and basic statistics.
- M B A 803      STATISTICAL ANALYSIS OF BUSINESS OPERATIONS**  
3 cr. (3 and 0)  
The role of statistical inference in the decision making of business managers; emphasis is on techniques and proper applications of modern statistical methods in business and on univariate and multivariate analysis, including analysis of variance, regression and covariance; sample theory and design, basic experimental designs and time series analysis. **Prerequisite:** Basic statistics.
- M B A 804      MANAGERIAL ACCOUNTING AND INFORMATION SYSTEMS**  
3 cr. (3 and 0)  
Preparation, analysis, interpretation and use of accounting information in the guidance and control of a business enterprise; case material and problems are used. **Prerequisites:** Principles of accounting and a demonstrated proficiency in basic finance.
- M B A 805      LEGAL AND SOCIAL ENVIRONMENT OF BUSINESS**  
3 cr. (3 and 0) S  
Interaction between business and the social, political and legal order; through analysis of particular situations, attention is focused on the broad effects of the total environment on the administration of business enterprise.
- M B A 806      OPERATIONS MANAGEMENT**  
3 cr. (3 and 0)  
Analytical methods as applied to business and industrial problems; basic mathematical and statistical models useful to management decision making in the functions of production, marketing, finance and general management are developed; emphasis is on the development and application of deterministic and probabilistic models to problems in forecasting, production scheduling, inventory, maintenance, queuing, plant location, product lines, line balancing, critical path methods and simulation. **Prerequisites:** M B A 803 and a demonstrated proficiency in basic management.
- M B A 807      FINANCIAL MANAGEMENT**  
(FIN 807) 3 cr. (3 and 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. **Prerequisite:** Principles of accounting.

- M B A 808      MANAGERIAL PROBLEMS IN MARKETING**  
3 cr. (3 and 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; emphasizes recent theoretical developments in marketing and related disciplines and their application in management; readings, case analysis and discussions are used. **Prerequisite:** Principles of marketing.
- M B A 809      ORGANIZATION THEORY AND BEHAVIOR**  
(MGT 809) 3 cr. (3 and 0) F  
Advanced consideration of theories and models as they apply to managing individual and work-group behavior in organizations. Topics include leadership, decision making, motivation, power, conflict, communication, job design and group processes. **Prerequisite:** Graduate standing.
- M B A 810      MANAGERIAL POLICY**  
3 cr. (3 and 0)  
Decisions involved in the establishment of managerial policy; problems, resources and alternative courses of action are analyzed and discussed 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. This course should be completed as the final course in the program.
- M B A 811      INTERNATIONAL BUSINESS MANAGEMENT**  
3 cr. (3 and 0) N  
Survey and analysis of economic, managerial and financial aspects of U.S. firms operating abroad, including the impact of U.S. and foreign government policies on management; case studies of specific companies operating abroad are discussed. **Prerequisites:** M B A 802 and 807 or equivalent.
- M B A 812      FINANCIAL MARKETS AND INSTITUTIONS**  
(FIN 812) 3 cr. (3 and 0) N  
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. **Prerequisite:** M B A/FIN 807 or M B A 857 or permission of instructor.
- M B A 813      INDUSTRIAL RELATIONS**  
3 cr. (3 and 0) N  
Relationship between management and employees, as institutions and as individuals; the role of management and unions in society; issues in labor-management relations. Topics



include the issues and processes of collective bargaining, contract negotiation and administration, and dispute resolution; government regulation of labor relations is also examined.

- M B A 814 DIRECTED RESEARCH IN QUANTITATIVE ANALYSIS**  
3 cr. (3 and 0) N
- M B A 815 DIRECTED RESEARCH IN QUALITATIVE ANALYSIS**  
3 cr. (3 and 0) N
- M B A 816 CONTRACTS, CORPORATE COORDINATION AND CONTROL**  
3 cr. (3 and 0) N  
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. **Prerequisite:** M B A 802 or equivalent.
- M B A 817 BUSINESS FORECASTING TECHNIQUES AND APPLICATIONS**  
3 cr. (3 and 0) N  
Forecasting techniques and their application for developing and assessing forecasts. Topics include economic data sources, multiple regression and time series analysis, and the interpretation of forecasts for management and other clients. **Prerequisite:** M B A 802, 803 or equivalent.
- M B A 820 BUSINESS COMMUNICATIONS AND ETHICS**  
3 cr. (3 and 0) F  
A case-based study of varied ethical and moral dilemmas encountered in the business environment, emphasizing the student's written work; development and communication of a reasoned personal framework for the resolution of ethical issues through frequent written assignments. **Prerequisite:** Graduate standing.
- M B A 822 CORPORATE FINANCIAL REPORTING**  
3 cr. (3 and 0) N  
Current state of financial reporting practices and requirements, the ways financial statements and data affect the economic system, and the significance of these practices to users of financial statements.
- M B A 823 INTERNATIONAL ACCOUNTING**  
3 cr. (3 and 0) N  
Technical and nontechnical issues in international accounting. Topics include the role of international bodies in developing standards, accounting issues dealing with exports and imports, and the role of accounting and MNCs in development.
- M B A 824 THE MANAGEMENT OF SALES OPERATIONS**  
3 cr. (3 and 0) N  
The sales function as an element of marketing strategy; the field of professional sales management; concepts and tools useful to managers at different levels of the sales organization.

**Prerequisite:** M B A 808 or 858 or permission of instructor.

- M B A 825 ADVERTISING AND PROMOTIONAL MANAGEMENT**  
3 cr. (3 and 0) N  
The role of promotion in the marketing mix, emphasizing the types of decisions and decision areas affiliated with promotional planning; students are exposed to and apply topics such as objective setting, budgeting, media planning and scheduling, and societal/economic impact of promotion. **Prerequisite:** M B A 808 or 858 or permission of instructor.
- M B A 826 BUSINESS MARKETING**  
3 cr. (3 and 0) N  
Strategic marketing as it applies to industrial, organizational and institutional markets; consumer marketing versus business-to-business marketing; current business marketing literature and practices. **Prerequisite:** M B A 808 or 858 or permission of instructor.
- M B A 828 SERVICES MARKETING**  
3 cr. (3 and 0) N  
The 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. **Prerequisite:** M B A 808 or 858 or permission of instructor.
- M B A 832 (FIN 832) INTERNATIONAL FINANCIAL MANAGEMENT**  
3 cr. (3 and 0) N  
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. **Prerequisite:** M B A/FIN 807 or M B A 857 or permission of instructor.
- M B A 835 (FIN 835) INVESTMENT MANAGEMENT**  
3 cr. (3 and 0) N  
Current techniques and strategies in the analysis of various investment alternatives; portfolio management with an introduction to options and futures markets. **Prerequisites:** Principles of accounting and a demonstrated proficiency in basic finance.
- M B A 836 (FIN 836) REAL ESTATE FINANCE AND INVESTMENTS**  
3 cr. (3 and 0) N  
Practices and analysis of real estate finance and investment. Topics include real estate financing techniques, mortgage loan underwriting, real estate ownership structure and syndications, real estate taxation and real estate investment risk analysis. **Prerequisite:** M B A/FIN 807 or M B A 857 or permission of instructor.



- M B A 840 WORLD INDUSTRIAL POLICY**  
3 cr. (3 and 0) SS  
Theory and institutions that form the basis for worldwide national industrial policies; examination of the basis for and effect of policies affecting mergers, consolidations, export assistance, coordination of industries, and other government actions taken that affect the legal and economic environment for transnational business. **Prerequisite:** M B A 802.
- M B A 851 FINANCIAL ACCOUNTING**  
3 cr. (3 and 0) F  
Accounting as a system which provides financial information for economic decision making; accounting from the perspective of the user in debt/equity financing activities and decisions, investing activities and decisions, and operating activities and decisions; measuring, processing and reporting financial information as a basis for better user understanding. **Prerequisite:** Permission of the M.B.A. director.
- M B A 852 FOUNDATIONS OF ECONOMICS**  
3 cr. (3 and 0) F  
Key concepts and theories in economics and how a market economy operates, concentrating on microeconomics, but also covering key macroeconomic topics. Topics covered include market systems, pricing mechanisms, monetary systems, inflation, employment, interest rates, consumer behavior and regulation. **Prerequisite:** Permission of the M.B.A. director.
- M B A 853 STATISTICAL ANALYSIS FOR BUSINESS**  
3 cr. (3 and 0) F  
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 with special attention given to efficient and relevant data collection and interpretation. **Prerequisite:** Permission of the M.B.A. director.
- M B A 854 MANAGERIAL ACCOUNTING**  
3 cr. (3 and 0) S  
Preparation, analysis and interpretation of internal accounting information used to guide and control the business organizations as well as nonbusiness enterprise; case materials and problems are used. **Prerequisite:** M B A 851 or permission of instructor.
- M B A 856 OPERATIONS MANAGEMENT**  
3 cr. (3 and 0) S  
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. **Prerequisites:** M B A 853 and 859 or permission of instructor.
- M B A 857 MANAGERIAL FINANCE**  
3 cr. (3 and 0) S  
Theory of financial management as it relates to 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; case analysis is used to bridge the gap between theory and practice. **Prerequisites:** M B A 851 and 852 or permission of instructor.
- M B A 858 MANAGERIAL MARKETING**  
3 cr. (3 and 0) S  
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. **Prerequisite:** M B A 853 or permission of instructor.
- M B A 859 MANAGEMENT SCIENCE APPLICATIONS**  
3 cr. (3 and 0) F  
Management science techniques and their application to a wide range of managerial decisions. Topics include queuing models, linear programming, transportation problems and simulation. **Prerequisite:** Permission of the M.B.A. director.
- M B A 860 ADVANCED MARKETING STRATEGY**  
3 cr. (3 and 0) F  
Advanced marketing theory and critical thinking skills applied to support strategic decision making; comprehensive case studies and advanced marketing models generally utilized with emphasis on building analysis and professional presentation skills. **Prerequisite:** M B A 858 or permission of instructor.
- M B A 861 (MGT 861) MANAGEMENT INFORMATION SYSTEMS DEVELOPMENT**  
3 cr. (3 and 0) SS  
See MGT 861 for description.
- M B A 862 MANAGERIAL ECONOMICS**  
3 cr. (3 and 0) S  
Use of economic analysis in managerial decision making. Topics include the theory of cost, production, industrial organization, coordination and control of the firm, property rights, and the economics of information, emphasizing the application of theoretical concepts to actual decision making. **Prerequisite:** M B A 852 or permission of instructor.
- M B A 867 (FIN 867) ADVANCED FINANCIAL MANAGEMENT**  
3 cr. (3 and 0)  
Students develop financial problem-solving skills through case analysis, class discussion, reading assignments and a project. **Prerequisite:** M B A/FIN 807 or M B A 857 or permission of instructor.



- M B A 870 STRATEGIC MANAGEMENT**  
3 cr. (3 and 0) S, SS  
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 used to integrate content from previous business courses. **Prerequisites:** M B A 805, 809, 820, 859, 860, 861 and 867 or permission of instructor.
- M B A 888 INTERNSHIP IN BUSINESS ADMINISTRATION**  
3 cr. (3 and 0)  
Preplanned, preapproved, faculty-supervised internships designed to give students on-the-job learning in support of classroom education; credit is not given for internships less than six full-time consecutive weeks with the same internship provider. May be repeated for a maximum of six credits. Does not count toward required graduation hours. Graded on a pass/fail basis. **Prerequisites:** Twenty-four semester hours of graduate credit and permission of the M B A director.
- M B A 889 ORGANIZATION DESIGN AND THEORY**  
3 cr. (3 and 0) N  
Topics include structuring of organizations, external environment, goals and effectiveness, organizational change, power and politics, organization culture and other topics focusing on the total organization, as opposed to individual behavior in organizations.
- M B A 890 TOPICS IN STRATEGIC MANAGEMENT**  
3 cr. (3 and 0) N  
In-depth coverage of a variety of issues facing today's executive; current relevant literature is examined and discussed in a graduate seminar environment. Topics may vary with each offering.
- M B A 895 TOPICS IN MARKETING**  
3 cr. (3 and 0) N  
In-depth study of a current topic in marketing. **Prerequisite:** M B A 808.

## Economics

William R. Dougan, Chair, Department of Economics

| Majors            | Degrees |
|-------------------|---------|
| Economics         | M.A.    |
| Applied Economics | Ph.D.   |

Applicants to the M.A. degree program must have completed at least 12 semester hours of undergraduate economics. A background in mathematics, including at least one course each in calculus and statistics, also is required.

Both thesis and nonthesis options are offered. The thesis option requires completion of 24 semester hours of course work and submission of an approved thesis. The nonthesis option requires completion of 30 semester hours of course work and a passing score on the M.A. qualifying examination.

Applicants to the Ph.D. program should have a strong background in economic theory and statistics.

- ECON 603 DEVELOPMENT OF ECONOMIC THOUGHT**  
3 cr. (3 and 0)
- ECON 604 COMPARATIVE ECONOMIC SYSTEMS**  
3 cr. (3 and 0)
- ECON 605 INTRODUCTION TO ECONOMETRICS**  
3 cr. (3 and 0)
- ECON 609 (MGT 609) MANAGERIAL ECONOMICS**  
3 cr. (3 and 0)
- ECON 610 ECONOMIC DEVELOPMENT**  
3 cr. (3 and 0)
- ECON 612 INTERNATIONAL MICROECONOMICS**  
3 cr. (3 and 0) S
- ECON 619 ECONOMICS OF DEFENSE**  
3 cr. (3 and 0)
- ECON 620 PUBLIC SECTOR ECONOMICS**  
3 cr. (3 and 0)
- ECON 622 MONETARY THEORY AND POLICY**  
3 cr. (3 and 0)
- ECON 624 THE ORGANIZATION OF INDUSTRIES**  
3 cr. (3 and 0) F
- ECON 750 ECONOMIC CONCEPTS AND CLASSROOM APPLICATIONS FOR TEACHERS**  
3 cr. (3 and 0)  
Economic concepts, analysis and methods emphasizing microeconomics and the market system; development of approaches to teaching economic concepts in public schools.
- ECON 751 SELECTED TOPICS FOR TEACHERS**  
3 cr. (3 and 0)  
Current economic policy issues, such as inflation, regulation, protectionism and energy policy, emphasizing the presentation of these topics to secondary school students. Topics vary from year to year. May be taken more than once for credit. **Prerequisite:** ECON 200, 211 or 750.
- ECON 800 (AP EC 800) HISTORY OF ECONOMIC THOUGHT**  
3 cr. (3 and 0)  
Development of economic thought from early Greek thought to Keynesian economics; writings of major economists such as Smith, Ricardo, Marx, Marshall and Keynes; development of major economic theories.
- ECON 801 (AP EC 801) MICROECONOMIC THEORY**  
3 cr. (3 and 0) F  
Microeconomic theory and its use to analyze and predict the behavior of industries, firms and consumers under various market conditions.
- ECON 802 (AP EC 802) ADVANCED ECONOMIC CONCEPTS AND APPLICATIONS**  
3 cr. (3 and 0)  
Rigorous development of price theory under alternative product and resource market structures. **Prerequisite:** Permission of instructor.



- ECON 805      MACROECONOMIC THEORY**  
3 cr. (3 and 0) S  
Macroeconomic theory involving static and dynamic models and their use in analysis of economic problems and policies.
- ECON 807      ECONOMETRICS II**  
(MA SC 807) 3 cr. (3 and 0) F  
(AP EC 807) 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.
- ECON 808      ECONOMETRICS III**  
(MA SC 808) 3 cr. (3 and 0) S  
(AP EC 808) Continuation of ECON 807; current economic models and estimation procedures. **Prerequisite:** ECON 807.
- ECON 811      ECONOMICS OF ENVIRONMENTAL QUALITY**  
(AP EC 811) 3 cr. (3 and 0) F (even numbered years)  
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. **Prerequisite:** ECON 314 or equivalent.
- ECON 816      LABOR ECONOMICS**  
(AP EC 816) 3 cr. (3 and 0)  
Wage and employment theory; labor markets; labor history; current problems in labor and manpower economics.
- ECON 820      PUBLIC FINANCE**  
(AP EC 820) 3 cr. (3 and 0)  
Impact of government on resource allocation, income distribution and stability; role of regulation; principles of taxation.
- ECON 824      ORGANIZATION OF INDUSTRY**  
(AP EC 824) 3 cr. (3 and 0)  
The structure of markets and firms; forces that determine the size of firms and the boundaries of markets; emphasis on the behavior of firms, both singly and in concert, to exploit market positions.
- ECON 826      ECONOMIC THEORY OF GOVERNMENT REGULATION**  
(AP EC 826) 3 cr. (3 and 0)  
The scope of governmental regulation in the economy of the United States, its evolution and development; emphasis on the application of the tools of economic analysis to the issues of regulated enterprise. **Prerequisite:** ECON 314 or equivalent.
- ECON 827      ECONOMICS OF PROPERTY RIGHTS**  
(AP EC 827) 3 cr. (3 and 0)  
Evolution and impact of various property rights institutions on individual behavior and the subsequent use of resources; particular attention given to the importance of property rights structures in the organization of business and in managerial decision making. **Prerequisite:** ECON 801.
- ECON 831      ECONOMIC DEVELOPMENT**  
(AP EC 831) 3 cr. (3 and 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 840      INTERNATIONAL TRADE THEORY**  
(AP EC 840) 3 cr. (3 and 0)  
Theory of free trade from Ricardo to present; theory and application of optimal and second-best tariffs; recent empirical testing of trade and tariff theory. **Prerequisites:** ECON 314 and 802 or permission of instructor.
- ECON 841      INTERNATIONAL FINANCE**  
(AP EC 841) 3 cr. (3 and 0)  
Financial economics of decision making in a multinational environment featuring autonomous governments and multiple currencies. Typical topics include examination of the macroeconomic problems of unemployment and inflation in an international economy, management of exchange rate risk, credit risk, political risk and taxation. **Prerequisite:** ECON 315 or equivalent.
- ECON 855      FINANCIAL ECONOMICS**  
(AP EC 855) 3 cr. (3 and 0)  
Modern theory of corporate finance; basic theories of efficient markets, portfolio selection, capital asset pricing, option pricing and agency costs. **Prerequisite:** ECON 801 or permission of instructor.
- ECON 888      DIRECTED READING IN ECONOMICS**  
(AP EC 888) 1-3 cr. (1-3 and 0)  
Directed reading and research in the student's field of interest. May be repeated for up to three credit hours.
- ECON 891      MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- ECON 900      SEMINAR IN ADVANCED ECONOMIC THEORY**  
3 cr. (3 and 0) F (odd numbered years)  
Selected topics that have been and are being discussed in scholarly journals.
- ECON 901      PRICE THEORY**  
(AP EC 901) 3 cr. (3 and 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. **Prerequisite:** ECON 801 or equivalent.
- ECON 903      GENERAL EQUILIBRIUM AND WELFARE THEORY**  
(AP EC 903) 3 cr. (3 and 0) S  
See AP EC 903 for description.



- ECON 904**  
(AP EC 904) **SEMINAR IN RESOURCE ECONOMICS**  
3 cr. (3 and 0) F  
See AP EC 904 for description.
- ECON 905**  
(AP EC 905) **ADVANCED MACROECONOMIC ISSUES**  
3 cr. (3 and 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. **Prerequisite:** ECON 805 or equivalent.
- ECON 906**  
(AP EC 906) **SEMINAR IN AREA ECONOMIC DEVELOPMENT**  
3 cr. (3 and 0) S  
See AP EC 906 for description.
- ECON 917**  
(AP EC 917) **ADVANCED SEMINAR IN LABOR ECONOMICS**  
3 cr. (3 and 0)  
Follow-up to ECON 816, bridging the gap between theory and modern empirical research in labor economics; emphasis on reading recent empirical research papers to understand the techniques of modern research in labor economics. **Prerequisite:** ECON 816.
- ECON 950**  
(AP EC 950) **MONETARY ECONOMICS**  
3 cr. (3 and 0)  
Economic analysis of money in our economy and effects of monetary policy on prices, interest rates, output and employment.
- ECON 991**  
(AP EC 991) **DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

## Finance

Robert B. McElreath, Chair, Department of Finance

Advanced degrees are not awarded in finance. Courses are offered to meet requirements and provide electives for students in other areas.

- FIN 605** **PORTFOLIO MANAGEMENT AND THEORY**  
3 cr. (3 and 0)
- FIN 606** **STOCK OPTIONS AND FUTURES MARKETS**  
3 cr. (3 and 0)
- FIN 610** **RESEARCH IN FINANCE**  
1-3 cr. (1-3 and 0)
- FIN 615** **REAL ESTATE INVESTMENT**  
3 cr. (3 and 0)
- FIN 617** **REAL ESTATE FINANCE**  
3 cr. (3 and 0)
- FIN 807**  
(M B A 807) **FINANCIAL MANAGEMENT**  
3 cr. (3 and 0)  
See M B A 807 for description.
- FIN 812**  
(M B A 812) **FINANCIAL MARKETS AND INSTITUTIONS**  
3 cr. (3 and 0) N  
See M B A 812 for description.

- FIN 832**  
(M B A 832) **INTERNATIONAL FINANCIAL MANAGEMENT**  
3 cr. (3 and 0) N  
See M B A 832 for description.

- FIN 835**  
(M B A 835) **INVESTMENT MANAGEMENT**  
3 cr. (3 and 0) N  
See M B A 835 for description.

- FIN 836**  
(M B A 836) **REAL ESTATE FINANCE AND INVESTMENTS**  
3 cr. (3 and 0) N  
See M B A 836 for description.

- FIN 867**  
(M B A 867) **ADVANCED FINANCIAL MANAGEMENT**  
3 cr. (3 and 0)  
See M B A 867 for description.

## Industrial Management

David W. Grigsby, Chair, Department of Management

| Major                 | Degrees     |
|-----------------------|-------------|
| Industrial Management | M.S., Ph.D. |

Requirements for the M.S. degree include a minimum of 48 semester hours of graduate work beyond the bachelor's degree. All students take 12 hours of foundation course work, 27 hours of core courses, and nine semester hours of a field project that extends over several academic terms. Admissions occur only in the fall semester, and all students must follow the same course sequence, requiring full-time enrollment, including summer sessions, through the end of the fall semester of the subsequent year.

The Ph.D. program is a balanced program of management theory, analytical technique and research methodology. Each student also must complete a minimum of 12 semester credit hours in a specified area of concentration. Choice of an area of concentration and selection of courses within the area is made in consultation with the student's advisory committee.

- MGT 602** **OPERATIONS PLANNING AND CONTROL**  
3 cr. (3 and 0)
- MGT 606** **LOCATION ECONOMICS**  
3 cr. (3 and 0)
- MGT 608** **DESIGN OF OPERATIONS SYSTEMS**  
3 cr. (3 and 0)
- MGT 609**  
(ECON 609) **MANAGERIAL ECONOMICS**  
3 cr. (3 and 0)
- MGT 615** **BUSINESS STRATEGY**  
3 cr. (3 and 0)
- MGT 616** **MANAGEMENT OF HUMAN RESOURCES**  
3 cr. (3 and 0)
- MGT 618** **MANAGEMENT INFORMATION SYSTEMS**  
3 cr. (3 and 0)
- MGT 620** **DEFENSE MANAGEMENT**  
3 cr. (3 and 0)
- MGT 623** **INTERNATIONAL BUSINESS MANAGEMENT**  
3 cr. (3 and 0)
- MGT 624** **INTERNATIONAL TRANSPORTATION AND LOGISTICS**  
3 cr. (3 and 0)



|                                      |                                                                                                                                                                                                                                                                                                                                                                                |                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>MGT 625</b>                       | <b>COMPENSATION MANAGEMENT</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                              |                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>MGT 801</b>                       | <b>PRODUCTION AND PRICING ANALYSIS</b><br>3 cr. (3 and 0)<br>Mathematical formulation of production and pricing theory as it applies to management decision making; analytical techniques of production and pricing analysis. <b>Prerequisite:</b> MGT 409/609 or permission of instructor.                                                                                    |                                      | order processing and warehousing of raw materials and finished goods. Topics also include interfaces with production/operations and marketing. <b>Prerequisite:</b> MGT 305 or 317 or permission of instructor.                                                                                                                                                                                                                                                                                                           |
| <b>MGT 803</b>                       | <b>OPERATIONS MANAGEMENT</b><br>3 cr. (3 and 0) F<br>Concepts and techniques of operations management. Topics include forecasting, aggregate planning, inventory management, scheduling and production control, project management and quality control. <b>Prerequisite:</b> MA SC 810 or equivalent.                                                                          | <b>MGT 813</b>                       | <b>BUSINESS RESEARCH</b><br>3 cr. (3 and 0)<br>Business research to support management decision making. Topics include information collection and analysis and report preparation and presentation; requires the use of integrated microcomputer software for the preparation of student reports. <b>Prerequisite:</b> MA SC 814 and MGT 399 or equivalent.                                                                                                                                                               |
| <b>MGT 804</b>                       | <b>MANAGERIAL POLICY</b><br>3 cr. (3 and 0) F<br>Management policy making, emphasizing determining objectives and developing sound policies for achieving them; builds upon and integrates the other graduate courses; case method is used extensively; written and oral presentation required. <b>Prerequisite:</b> MGT 803, M B A/FIN 807 or permission of instructor.       | <b>MGT 815</b>                       | <b>PERSONNEL MANAGEMENT</b><br>3 cr. (3 and 0)<br>Personnel management activities, including recruitment, selection, training and development, performance appraisal, discipline, grievance handling, wage and salary administration, and employee benefit programs. <b>Prerequisite:</b> Graduate standing.                                                                                                                                                                                                              |
| <b>MGT 805</b>                       | <b>ADVANCED QUALITY CONTROL</b><br>3 cr. (3 and 0) F<br>Statistical techniques employed in complex quality control schemes including recent developments in statistical quality control. <b>Prerequisites:</b> MTHSC 301 and MGT 404 or equivalent.                                                                                                                            | <b>MGT 818</b>                       | <b>MANAGEMENT SUPPORT SYSTEMS</b><br>3 cr. (3 and 0)<br>Computer-based management support systems.                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>MGT 807</b>                       | <b>COMPARATIVE MANAGEMENT THEORY</b><br>3 cr. (3 and 0)<br>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. <b>Prerequisite:</b> Graduate standing.                                                                    | <b>MGT 820</b>                       | <b>SERVICE OPERATIONS MANAGEMENT</b><br>3 cr. (3 and 0)<br>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. <b>Prerequisite:</b> MGT 803 or permission of instructor.                                                                                                                 |
| <b>MGT 808</b>                       | <b>MANUFACTURING PLANNING AND CONTROL SYSTEMS</b><br>3 cr. (3 and 0) F<br>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. <b>Prerequisite:</b> MGT 803 or permission of instructor. | <b>MGT 821</b>                       | <b>PROCESS AND FACILITY DESIGN</b><br>3 cr. (3 and 0)<br>Design of operating systems, emphasizing the implications of technology and automation. Topics include technological core competencies, technological forecasting, process design, capacity planning, facility location and layout, and product and process development processes. <b>Prerequisites:</b> MGT 803 or permission of instructor.                                                                                                                    |
| <b>MGT 809</b><br><b>(M B A 809)</b> | <b>ORGANIZATION THEORY AND BEHAVIOR</b><br>3 cr. (3 and 0) F<br>Advanced consideration of theories and models as they apply to managing individual and work-group behavior in organizations. Topics include leadership, decision making, motivation, power, conflict, communication, job design and group processes. <b>Prerequisite:</b> Graduate standing.                   | <b>MGT 822</b>                       | <b>INTERNATIONAL OPERATIONS MANAGEMENT</b><br>3 cr. (3 and 0)<br>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. <b>Prerequisite:</b> MGT 803 or permission of instructor. |
| <b>MGT 812</b>                       | <b>BUSINESS LOGISTICS MANAGEMENT</b><br>3 cr. (3 and 0) SS<br>In-depth examination of business activities related to transportation, inventory management,                                                                                                                                                                                                                     | <b>MGT 861</b><br><b>(M B A 861)</b> | <b>MANAGEMENT INFORMATION SYSTEMS DEVELOPMENT</b><br>3 cr. (3 and 0) SS<br>Overview of information technologies used by organizations for supporting operations and                                                                                                                                                                                                                                                                                                                                                       |



gaining competitive advantage; concepts and methods for modeling, analysis and design of information systems which support a business. Topics include systems analysis, object-oriented modeling and database design. **Prerequisite:** Basic computer skills as specified in prerequisites for the master's degree program.

MGT 888

### INTERNATIONAL PERSPECTIVES IN INDUSTRIAL MANAGEMENT

3-6 cr. (3-6 and 0)

International perspective to industrial management via organized plant visitations to businesses in a foreign country and lectures by, and discussions with, senior operations manager(s); cultural visits and lectures are also organized to provide a holistic perspective to cover cultural and economic development of the host country. **Prerequisite:** Permission of instructor.

MGT 891

### MASTER'S THESIS RESEARCH

Credit to be arranged.

MGT 892

### MASTER'S PROJECT COURSE

3 cr. (0 and 9)

The field project, the capstone activity in the program, requires application of the program body of knowledge to a real-world operations management problem; a formal presentation and written report are required. May be repeated for a maximum of twelve credit hours. **Prerequisite:** Permission of instructor.

MGT 903

### SEMINAR IN MANUFACTURING PLANNING AND CONTROL SYSTEMS

3 cr. (3 and 0)

Current research issues and developments in manufacturing planning and control systems, emphasizing current research (philosophical, analytical and empirical) dealing with alternative approaches for planning and control of manufacturing operations. **Prerequisite:** MGT 803 or permission of instructor.

MGT 904

### SEMINAR IN CURRENT MANAGEMENT TOPICS

3 cr. (3 and 0)

Topics from current management literature; emphasis is on research from scholarly journals. Topics vary in keeping with developments in the literature. May be repeated with different faculty for a maximum of six credit hours. **Prerequisite:** Permission of instructor.

MGT 905

### RESEARCH METHODS

3 cr. (3 and 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. Enrollment restricted to doctoral students. **Prerequisite:** MA SC 814 or equivalent.

MGT 910

### SEMINAR IN OPERATIONS MANAGEMENT

1-3 cr. (1-3 and 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. **Prerequisite:** Permission of instructor.

MGT 911

### SEMINAR IN DECISION THEORY

1-3 cr. (1-3 and 0)

Framework and methodology for management decision making in a statistical setting. **Prerequisite:** Permission of instructor.

MGT 913

### MANAGEMENT SYSTEMS ANALYSIS

3 cr. (3 and 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; emphasis is on effect of model results on managerial policy decisions. **Prerequisite:** CP SC 150 or equivalent.

MGT 915

### SEMINAR IN BUSINESS-LEVEL STRATEGY FORMULATION AND IMPLEMENTATION

3 cr. (3 and 0)

Theoretical and empirical foundations of business-level strategy research, focusing on how firms compete in a particular business; strategic typologies, the strategic management process, strategy-environment fit, organization performance, business-unit culture, and functional strategies and structure. **Prerequisite:** MGT 804.

MGT 916

### DIRECTED READINGS IN MANAGEMENT

1-3 cr. (1-3 and 0)

Directed reading and research in the student's area of interest. May be repeated for a maximum of three credit hours. **Prerequisite:** Permission of instructor.

MGT 918

### SEMINAR IN MANAGEMENT SUPPORT SYSTEMS

3 cr. (3 and 0)

Contemporary topics in decision-oriented information systems research; structure of the field, research methodologies and research opportunities. **Prerequisite:** MGT 818 or permission of instructor.

MGT 921

### SEMINAR IN THE SCIENCE AND PRACTICE OF BUSINESS AND ECONOMIC MODELING

3 cr. (3 and 0)

Current literature used as a resource for studying and analyzing selected topics important in the design and development of simulation models; students lead and participate in group discussions. **Prerequisite:** MGT 913 or equivalent.

MGT 950

### SEMINAR IN CORPORATE-LEVEL STRATEGY FORMULATION AND IMPLEMENTATION

3 cr. (3 and 0)

Theoretical and empirical foundations of corporate-level strategy research, emphasizing both formulation and implementation issues; boards of directors, decision making, diversification, strategic fit, mergers and acquisitions, divestitures, joint ventures and corporate structure. **Prerequisite:** MGT 804.



- MGT 952 SEMINAR IN MANUFACTURING AND OPERATIONS STRATEGY**  
3 cr. (3 and 0)  
Emerging theoretical and empirical research showing the linkages among competitive business priorities, patterns of operations decisions and firm performance. Topics include development of operations objectives and strategies that reflect competitive priorities, and strategic operations decisions in the areas of process, capacity, facility, and planning and control systems. **Prerequisite:** MGT 804.
- MGT 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.
- H ADM 608 HOSPITAL AND HEALTH SERVICES ADMINISTRATION**  
3 cr. (3 and 0)
- H ADM 610 HOSPITAL INTERNSHIP**  
3 cr. (0 and 9)

### Management Science

Peter R. Nelson, Program Coordinator, Department of Mathematical Sciences

| Major              | Degree |
|--------------------|--------|
| Management Science | Ph.D.  |

The departments of Management and Mathematical Sciences (College of Engineering and Science) jointly offer and administer this program. Applicants should have a demonstrated aptitude for quantitative analysis and a primary interest in scientific management research and practice.

- MA SC 807 ECONOMETRICS II**  
(ECON 807) 3 cr. (3 and 0) F  
(AP EC 807) See ECON 807 for description.
- MA SC 808 ECONOMETRICS III**  
(ECON 808) 3 cr. (3 and 0) S  
(AP EC 808) See ECON 808 for description.
- MA SC 810 FOUNDATIONS OF MANAGEMENT SCIENCE**  
3 cr. (3 and 0) S  
Fundamental management science modeling techniques, emphasizing problem formulation, computer solution and economic analysis in an operations context; concepts include 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. **Prerequisite:** MGT 803 or equivalent.
- MA SC 812 MANAGEMENT SCIENCE II**  
3 cr. (3 and 0) F  
Continuation of MA SC 810; dynamic, integer and nonlinear programming, emphasizing applications of different types of mathematical programming to business and industrial problems. **Prerequisite:** MA SC 810 or permission of instructor.
- MA SC 814 DESIGN OF EXPERIMENTS IN BUSINESS AND MANAGEMENT**  
3 cr. (3 and 0) S  
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.

*Management science students are required to take some of the following courses offered by various departments. Descriptions for all 800-level courses are under the respective departmental headings.*

- MGT 801 PRODUCTION AND PRICING ANALYSIS**  
3 cr. (3 and 0)
- MGT 803 OPERATIONS MANAGEMENT**  
3 cr. (3 and 0) F
- MGT 804 MANAGERIAL POLICY**  
3 cr. (3 and 0) F
- MGT 807 COMPARATIVE MANAGEMENT THEORY**  
3 cr. (3 and 0)
- MGT 809 ORGANIZATION THEORY AND BEHAVIOR**  
(M B A 809) 3 cr. (3 and 0) F
- MGT 910 SEMINAR IN OPERATIONS MANAGEMENT**  
1-3 cr. (1-3 and 0)
- MGT 911 SEMINAR IN DECISION THEORY**  
1-3 cr. (1-3 and 0)
- MGT 913 MANAGEMENT SYSTEMS ANALYSIS**  
3 cr. (3 and 0)
- MTHSC 606 SAMPLING THEORY AND METHODS**  
3 cr. (3 and 0)
- MTHSC 641 INTRODUCTION TO STOCHASTIC MODELS**  
3 cr. (3 and 0)
- MTHSC 800 PROBABILITY**  
3 cr. (3 and 0) F
- MTHSC 801 GENERAL LINEAR HYPOTHESIS I**  
3 cr. (3 and 0) F
- MTHSC 802 GENERAL LINEAR HYPOTHESIS II**  
3 cr. (3 and 0) S
- MTHSC 803 STOCHASTIC PROCESSES**  
3 cr. (3 and 0) S, SS
- MTHSC 805 DATA ANALYSIS**  
3 cr. (3 and 0) F, S
- MTHSC 809 TIME SERIES ANALYSIS, FORECASTING AND CONTROL**  
3 cr. (3 and 0) F
- MTHSC 810 MATHEMATICAL PROGRAMMING**  
3 cr. (3 and 0) F, S
- MTHSC 811 NONLINEAR PROGRAMMING**  
3 cr. (3 and 0) S
- MTHSC 813 ADVANCED LINEAR PROGRAMMING**  
3 cr. (3 and 0) S



|                  |                                                                         |
|------------------|-------------------------------------------------------------------------|
| <b>MTHSC 814</b> | <b>NETWORK FLOW PROGRAMMING</b><br>3 cr. (3 and 0) F                    |
| <b>MTHSC 817</b> | <b>STOCHASTIC MODELS IN OPERATIONS RESEARCH I</b><br>3 cr. (3 and 0) F  |
| <b>MTHSC 818</b> | <b>STOCHASTIC MODELS IN OPERATIONS RESEARCH II</b><br>3 cr. (3 and 0) S |
| <b>MTHSC 860</b> | <b>AN INTRODUCTION TO SCIENTIFIC COMPUTING</b><br>3 cr. (3 and 0) S, SS |
| <b>MTHSC 881</b> | <b>MATHEMATICAL STATISTICS</b><br>3 cr. (3 and 0) S                     |
| <b>MTHSC 907</b> | <b>MULTIVARIATE ANALYSIS</b><br>3 cr. (3 and 0) N                       |

## Marketing

Richard M. Reese, Chair, Department of Marketing

Advanced degrees are not awarded in marketing. Courses are offered to provide electives for students in other areas.

|                |                                                          |
|----------------|----------------------------------------------------------|
| <b>MKT 627</b> | <b>INTERNATIONAL MARKETING</b><br>3 cr. (3 and 0)        |
| <b>MKT 629</b> | <b>PUBLIC AND NONPROFIT MARKETING</b><br>3 cr. (3 and 0) |
| <b>MKT 630</b> | <b>MARKETING PRODUCT MANAGEMENT</b><br>3 cr. (3 and 0)   |
| <b>MKT 631</b> | <b>MARKETING RESEARCH</b><br>3 cr. (3 and 0)             |
| <b>MKT 638</b> | <b>TECHNICAL MARKETING</b><br>3 cr. (3 and 0)            |
| <b>MKT 695</b> | <b>SELECTED TOPICS</b><br>3 cr. (3 and 0)                |

## School of Education

Department of Curriculum and Instruction  
Robert P. Green, Jr., Chair

Department of Educational Leadership and Counseling  
Jackson L. Flanigan, Chair

Department of Graphic Communications  
William E. West, Chair

Department of Special Education and Foundations  
William R. Fisk, Chair

Department of Technology and Human Resource Development  
Gerald G. Lovedahl, Chair

| <b>Majors</b>                    | <b>Degrees</b> |
|----------------------------------|----------------|
| Administration and Supervision   | M.Ed., Ed.S.   |
| Counseling and Guidance Services | M.Ed.          |
| Curriculum and Instruction       | Ph.D.          |
| Educational Leadership           | Ph.D.          |
| Elementary Education             | M.Ed.          |
| Human Resource Development       | M.H.R.D.       |

|                                |          |
|--------------------------------|----------|
| Industrial Education           | M.In.Ed. |
| Reading                        | M.Ed.    |
| Secondary Education            | M.Ed.    |
| Special Education              | M.Ed.    |
| Vocational/Technical Education | Ed.D.    |

Students seeking admission to the Master of Education degree programs with majors in administration and supervision, counseling and guidance services (in the areas of elementary school counseling or secondary school counseling), elementary education, reading, secondary education and special education should have a valid professional teacher's certificate on the appropriate level. Those seeking admission to the counseling and guidance services program in the area of student affairs in higher education must have an undergraduate degree in a human services area or experience in higher education. Those seeking admission to the vocational counseling/community agency area must have 15 hours of sociology and/or psychology, including a course in learning theory and a course in human development.

A major in educational administration and supervision is offered to experienced teachers (at least one year) who wish to prepare as elementary school administrators or supervisors, or secondary school administrators or supervisors. Appropriate scores on the Graduate Record Examinations (GRE) or the Miller Analogies Test (MAT) are required. The 39 hours and courses are selected from four areas as prescribed by the Department of Curriculum and Instruction.

The Specialist in Education degree program in educational administration consists of a minimum of 30 semester hours beyond the master's degree selected from areas prescribed by the Department of Curriculum and Instruction. Admission requirements include a master's degree and appropriate GRE/MAT scores.

A major in counseling and guidance services requires 42 hours and is offered to those desiring to specialize in guidance counseling in the public schools, higher education or the vocational counseling/community agency field. Degree candidates are required to complete a minimum of 24 hours, including 6 hours of field experience, in the area of specialization; 3 to 6 hours in statistics and research; and 12 to 15 hours in a field related to the area of specialization.

The Doctor of Philosophy degree in curriculum and instruction requires a minimum of 70 semester hours beyond the master's degree, selected from the areas prescribed by the Department of Curriculum and Instruction. Admission requirements include a master's degree and appropriate GRE scores.

The Doctor of Philosophy degree in educational leadership requires a minimum of 72 semester hours beyond the master's degree, selected from either K-12 administration or higher education administration. Admission requirements include a master's degree and appropriate GRE scores.

A major in elementary education is offered to teachers who hold professional early childhood or elementary certificates. The 36 hours and courses may be selected from six areas as prescribed by the Department of Curriculum and Instruction.

A major in reading is offered for reading specialists, consultants and/or supervisors. The 36 semester hours are prescribed by the Department of Curriculum and Instruction.

A major in secondary education is offered to high school or prospective junior college teachers in the subject areas of English, history and government, mathematics and natural sciences. Candidates are required to complete a minimum of 15 semester hours in graduate courses in education and a minimum of 18 hours in graduate courses in the content area. A total of 36 semester hours is required.

A major in special education is offered to those desiring specialization in the areas of mental retardation, emotional handicaps and learning disabilities. Appropriate certification is a prerequisite for admission. The 36 hours and courses are prescribed by the Department of Curriculum and Instruction.



Applicants to the HRD program are reviewed on undergraduate course work, academic performance and employment experience. The HRD program requires 36 hours, including 15 hours in core human resource development courses, 6 hours in research methods and 15 hours in course work appropriate to individual career objectives.

In addition to the general requirements for admission to the Graduate School, industrial education program requirements for admission to each of the areas of specialization are as follows:

1. Industrial technology education applicants must hold or meet the minimum requirements for an industrial arts or technology teacher's certificate.
2. Vocational/technical education applicants must hold or meet the minimum requirements for a trade and industrial teacher's certificate, or show vocational or technical competence through training, work experience or proficiency test results.
3. The program in administration and supervision for the two-year college requires the applicant to show evidence of competency in a teaching area or to have a minimum of 24 semester hours of courses appropriate to the vocational or technical program to be administered or supervised.
4. Graphic communications specialists must have a technical background in one or more phases of graphic communications or complete a specified sequence of prerequisite courses.

Candidates for the Master of Industrial Education degree are required to complete 18 hours in subjects that contribute to the student's technical, administrative and/or supervisory competence; 6 hours in research and special problems; and 6 to 12 hours taken outside the major department.

An applicant for the Ed.D. degree must hold bachelor's and master's degrees from approved colleges, must have completed a minimum of three years of successful experience appropriate to his or her proposed field of professional service, and must have satisfactory GRE scores.

Areas of specialization are available in administration (technical colleges and public schools); curriculum and instruction (technical colleges, industry and public schools), emphasizing curriculum development, materials and instructional technologies, and human resource development; guidance (technical colleges, public schools and vocational agencies); and teaching (technical colleges and public schools).

The Ed.D. program consists of graduate course work, an internship in an appropriate field of professional service, and a dissertation.

**ED 614 (PRTM 614) RECREATION AND LEISURE FOR SPECIAL POPULATIONS**  
3 cr. (3 and 0)

**ED 615 (PRTM 615) DESIGNING COMPREHENSIVE SERVICES FOR ELEMENTARY CHILDREN AT RISK FOR SCHOOL FAILURE**  
3 cr. (2 and 3)

**ED 631 SPECIAL INSTITUTE COURSE: EARLY CHILDHOOD EDUCATION**  
1-3 cr. (1-3 and 0)

**ED 632 SPECIAL INSTITUTE COURSE: ELEMENTARY SCHOOL**  
1-3 cr. (1-3 and 0)

**ED 633 SPECIAL INSTITUTE COURSE: SECONDARY SCHOOL**  
1-3 cr. (1-3 and 0)

**ED 634 SPECIAL INSTITUTE COURSE FOR COMPARATIVE STUDIES IN EDUCATION**  
1-3 cr. (1-3 and 0)

**ED 635 SPECIAL INSTITUTE COURSE: CURRICULUM**  
1-3 cr. (1-3 and 0)

**ED 640 ADVANCED PHYSICAL EDUCATION METHODS OF THE CLASSROOM TEACHER**  
3 cr. (3 and 0)

**ED 641 MIDDLE SCHOOL CURRICULUM**  
3 cr. (3 and 0)

**ED 669 CHARACTERISTICS OF CHILDREN WITH EMOTIONAL HANDICAPS**  
3 cr. (3 and 0)

**ED 670 CHARACTERISTICS OF CHILDREN WITH LEARNING DISABILITIES**  
3 cr. (3 and 0)

**ED 671 THE EXCEPTIONAL CHILD**  
3 cr. (3 and 0)

**ED 672 PSYCHOLOGY OF MENTAL RETARDATION**  
3 cr. (3 and 0)

**ED 673 TEACHING THE MENTALLY RETARDED**  
3 cr. (3 and 0)

**ED 674 EDUCATIONAL PROCEDURES FOR CHILDREN WITH EMOTIONAL HANDICAPS**  
3 cr. (3 and 0)

**ED 675 EDUCATIONAL PROCEDURES FOR CHILDREN WITH LEARNING DISABILITIES**  
3 cr. (3 and 0)

**ED 676 PRACTICUM IN LEARNING DISABILITIES**  
3 cr. (2 and 3)

**ED 677 CHARACTERISTICS OF CHILDREN WHO ARE GIFTED**  
3 cr. (3 and 0)

**ED 678 PRACTICUM IN EMOTIONALLY HANDICAPPED**  
3 cr. (2 and 3)

**ED 679 PRACTICUM IN MENTALLY RETARDED**  
3 cr. (2 and 3)

**ED 680 (IN ED 680) (AG ED 680) (COLED 680) EDUCATIONAL APPLICATIONS OF MICROCOMPUTERS**  
3 cr. (3 and 0)

**ED 682 (IN ED 682) (AG ED 682) (COLED 682) ADVANCED EDUCATIONAL APPLICATIONS OF MICROCOMPUTERS**  
3 cr. (2 and 2)

**ED 690 STUDENT MANAGEMENT AND DISCIPLINE**  
3 cr. (3 and 0)

**ED 697 AUDIOVISUAL AIDS IN EDUCATION**  
3 cr. (3 and 0)



- ED 700 (IN ED 700) SUPERVISING THE STUDENT TEACHER IN THE PUBLIC SCHOOL**  
2-3 cr. (2-3 and 0)  
Knowledge and skills desirable for supervisors of student teachers; use of observation instruments for recording objective data and evaluating teaching performance is explored. Graded on a pass/fail basis. **Prerequisites:** A professional teaching certificate, at least one year of teaching experience, a recommendation from the employing school district or consent of the instructor.
- ED 701 HUMAN GROWTH AND DEVELOPMENT**  
3 cr. (3 and 0)  
Theory and research in human development and its impact on the teaching/learning process. **Prerequisites:** ED 334, 335, 336 or equivalent; classroom teaching experience.
- ED 702 ADVANCED EDUCATIONAL PSYCHOLOGY**  
3 cr. (3 and 0)  
Educational applications of research and theory on objectives, motivation, class climate, class management and learning theory. **Prerequisite:** ED 302 or equivalent; classroom teaching experience recommended.
- ED 707 READING AND INDEPENDENT STUDY IN EDUCATION**  
1-3 cr. (1-3 and 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. **Prerequisite:** Permission of instructor.
- ED 712 MULTICULTURAL COUNSELING**  
3 cr. (3 and 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 734 ADDICTIONS COUNSELING**  
3 cr. (3 and 0)  
Comprehensive overview of the phenomenon of chemical dependence and addiction; current methods of identification and intervention; and awareness of how addictions affect individuals, families, schools and communities. **Prerequisite:** Permission of instructor.
- ED 740 CURRICULUM PLANNING FOR EARLY CHILDHOOD EDUCATION**  
3 cr. (3 and 0)  
Introduction to early childhood education (ages five through eight); the nature of learning and its bearing upon curriculum; early childhood curriculum content. **Prerequisite:** Permission of instructor.
- ED 741 STUDENT DEVELOPMENT SERVICES IN HIGHER EDUCATION**  
3 cr. (3 and 0)  
Pupil personnel services offered by institutions of higher education.
- ED 742 THEORIES OF STUDENT DEVELOPMENT IN HIGHER EDUCATION**  
3 cr. (3 and 0)  
Developmental aspects of the young adult age group and the relationship to postsecondary schools and training programs.
- ED 759 FUNDAMENTALS OF BASIC READING**  
3 cr. (3 and 0)  
Historical progression of the teaching of reading; current theories and reading practices; teaching basic reading skills.
- ED 760 CURRICULUM DEVELOPMENT IN THE ELEMENTARY SCHOOL**  
3 cr. (3 and 0)  
Curriculum planning practices in the elementary school.
- ED 761 READING INSTRUCTION IN THE ELEMENTARY SCHOOL**  
3 cr. (3 and 0)  
Knowledge and skills necessary for teaching reading to varied types of elementary school learners.
- ED 762 READING DIAGNOSIS AND REMEDIATION**  
3 cr. (2 and 3)  
Remedial methods and materials for teaching reading; use of diagnostic instruments and interpretation of test results. Student participates in laboratory/field experience and prepares case study with summary of diagnosis emphasizing remediation procedures. **Prerequisite:** Three semester hours in reading or permission of instructor.
- ED 763 MIDDLE SCHOOL READING**  
3 cr. (3 and 0)  
Techniques, materials and theories for teaching reading to middle school students, emphasizing correlating reading skills into the content area. **Prerequisite:** Education major or permission of instructor.
- ED 764 THE ROLE OF THE LIBRARY IN THE READING PROGRAM**  
3 cr. (3 and 0)  
Prepares librarians to work with teachers and pupils, and prepares teachers to work with librarians and pupils in the reading program. **Prerequisite:** Employment as a teacher or librarian and/or permission of instructor.
- ED 765 SECONDARY SCHOOL CURRICULUM**  
3 cr. (3 and 0)  
Principles, techniques and trends in secondary school curriculum development and evaluation. **Prerequisite:** Graduate status.
- ED 766 INTEGRATING SERVICE LEARNING INTO CURRICULUM**  
3 cr. (2 and 2)  
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. **Prerequisite:** Teaching certification.



- ED 778 EXPERIMENTAL AND NONEXPERIMENTAL RESEARCH METHODS IN EDUCATION I**  
3 cr. (3 and 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. **Prerequisite:** EX ST 301 or equivalent or permission of instructor; ED 808 recommended.
- ED 798 TEACHING SECONDARY SCHOOL READING**  
3 cr. (3 and 0)  
Methods and materials for secondary reading programs in developmental, corrective, remedial, adapted, content and recreational areas.
- ED 800 FOUNDATIONS OF SECONDARY SCHOOL COUNSELING AND GUIDANCE**  
3 cr. (3 and 0)  
Counseling and guidance programs in the secondary school; principles, programs and policies underlying programs.
- ED 803 ADVANCED METHODS OF TEACHING IN THE SECONDARY SCHOOL**  
3 cr. (3 and 0)  
Principles and practices involved in promoting effective learning in secondary schools.
- ED 804 ADVANCED METHODS OF TEACHING IN THE ELEMENTARY SCHOOL**  
3 cr. (3 and 0)  
Principles and practices involved in promoting effective learning in elementary schools; analysis and evaluation of educational media.
- ED 806 FOUNDATIONS OF COUNSELING IN THE ELEMENTARY SCHOOL**  
3 cr. (3 and 0)  
Specialized information concerning theory and practice of elementary school counseling; opportunity to explore elementary school counseling techniques.
- ED 807 COUNSELING IN COMMUNITY AGENCY SETTING**  
3 cr. (3 and 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; emphasis on theoretical perspectives of mental disorders, diagnostic concepts and frameworks, treatment and intervention models, and counseling theory.
- ED 808 EDUCATIONAL TESTS AND MEASUREMENTS**  
3 cr. (3 and 0)  
Construction, use and interpretation of subjective and standard tests; measurement applications.
- ED 809 ANALYSIS OF THE INDIVIDUAL**  
3 cr. (2 and 1)  
Experience in gathering, interpreting and utilizing data as it relates to the individual; especially significant to counselors. **Prerequisite:** ED 808 or permission of instructor.
- ED 810 THEORIES AND TECHNIQUES OF COUNSELING**  
3 cr. (3 and 0)  
Counseling theories and techniques. **Prerequisite:** ED 800, 806 or permission of instructor.
- ED 812 THE SCHOOL COUNSELOR AS CONSULTANT**  
3 cr. (3 and 0)  
Rationale, content and consultation process in school and nonschool settings; study of and practice in various consulting activities. **Prerequisite:** ED 806 or permission of instructor.
- ED 813 EDUCATIONAL AND VOCATIONAL INFORMATION SERVICES AND PLACEMENT**  
3 cr. (3 and 0)  
Gathering, interpreting and utilizing educational, social and occupational information; techniques used in placement, survey and follow-up.
- ED 814 FIELD EXPERIENCES IN ELEMENTARY SCHOOL GUIDANCE I**  
3 cr. (1 and 6)  
Supervised field experience in counseling and other services in an elementary school. **Prerequisite:** ED 806, 810, 817 or permission of instructor.
- ED 815 FIELD EXPERIENCES IN SECONDARY SCHOOL GUIDANCE I**  
3 cr. (1 and 6)  
Supervised field experience in counseling and other services in a secondary school setting. **Prerequisites:** ED 810 and 817.
- ED 816 FIELD EXPERIENCES IN COUNSELING IN POSTSECONDARY SETTINGS I**  
3 cr. (1 and 6)  
Supervised field experience in counseling and other student services in a postsecondary school setting. **Prerequisite:** ED 800, 810, 817 or permission of instructor.
- ED 817 DEVELOPMENT OF COUNSELING SKILLS**  
3 cr. (3 and 0)  
On-campus experience to help counselors develop communication skills through role-playing activities, audio and videotaping, interviewing, lecture and discussion. **Prerequisite or Corequisite:** ED 810.
- ED 819 ADVANCED COUNSELING TECHNIQUES AND STRATEGIES**  
3 cr. (3 and 0)  
Development of in-depth counseling skills; techniques for working with a wide variety of populations and/or problems. **Prerequisites:** ED 810, 817, 871 and completion of 30 hours in a master's program in counseling or certification as a school counselor.



- ED 820 TEACHING LANGUAGE ARTS TO THE EXCEPTIONAL CHILD**  
3 cr. (3 and 0)  
Various approaches to teaching listening, writing, reading and speaking skills to the exceptional child.
- ED 821 ASSESSMENT OF THE EXCEPTIONAL CHILD**  
3 cr. (3 and 0)  
Interpreting psychological reports, writing educational prescriptions, administering selected tests and designing informal tests. **Prerequisites:** ED 471/671 and sequence of ED 472/672 or ED 469/669 and 474/674 and 476/676; or ED 470/670 and 475/675.
- ED 822 TEACHING MATHEMATICS TO THE EXCEPTIONAL CHILD**  
3 cr. (3 and 0)  
Various approaches to teaching mathematics to the exceptional child.
- ED 823 MAINSTREAMING THE HANDICAPPED**  
3 cr. (3 and 0)  
Needs of the handicapped and instructional strategies for accommodating exceptional children in the mainstream. For regular classroom teachers and administrators. **Prerequisite:** Permission of instructor.
- ED 824 SECONDARY CURRICULUM ADAPTATIONS FOR THE HANDICAPPED**  
3 cr. (3 and 0)  
Designed for teachers of handicapped students in secondary schools; adaptation of curriculum and instruction to meet the needs of students with mild to moderate learning handicaps. Topics include text modification, study skills, curriculum design and mainstreaming. **Prerequisite:** ED 471/671 or permission of instructor.
- ED 825 CAREER/VOCATIONAL EDUCATION FOR THE HANDICAPPED**  
3 cr. (3 and 0)  
Designed for special education teachers at the secondary level to attain the necessary competency to assist the handicapped adolescent in preparing for the world of work. **Prerequisite:** ED 471/671 or permission of instructor.
- ED 828 FIELD EXPERIENCES IN ELEMENTARY SCHOOL GUIDANCE II**  
3 cr. (1 and 6)  
Additional field experiences in counseling, consulting and coordinating services for the elementary school child. **Prerequisite:** ED 806, 810, 814, 817 or permission of instructor.
- ED 829 FIELD EXPERIENCES IN SECONDARY SCHOOL GUIDANCE II**  
3 cr. (1 and 6)  
Additional field experiences in counseling, consulting and coordinating services for the secondary school student. **Prerequisites:** ED 810, 815, 817 and 30 hours completed in the program.
- ED 832 FIELD EXPERIENCES IN COUNSELING IN POSTSECONDARY SETTINGS II**  
3 cr. (1 and 6)  
Additional supervised field experience in counseling and other student services in a post-secondary setting. **Prerequisite:** ED 810, 816, 817 or permission of instructor.
- ED 835 FIELD EXPERIENCES IN COUNSELING IN COMMUNITY AGENCY SETTINGS I**  
3 cr. (1 and 6)  
Supervised field experiences in counseling and other services in a community agency setting. **Prerequisite:** ED 810, 817 or permission of instructor.
- ED 836 FIELD EXPERIENCES IN COUNSELING IN COMMUNITY AGENCY SETTINGS II**  
3 cr. (1 and 6)  
Additional field experiences in counseling and other agency activities. **Prerequisite:** ED 810, 817, 835 or permission of instructor.
- ED 837 ADVANCED METHODS IN ELEMENTARY SCIENCE**  
3 cr. (3 and 0)  
Current research and trends in elementary science teaching methods and curriculum development; students examine recent literature and proposed standards for science teaching and develop strategies to implement recommended practices in their own classrooms. **Prerequisite:** Elementary teaching experience.
- ED 840 PROGRAM DEVELOPMENT AND IMPLEMENTATION IN EARLY CHILDHOOD EDUCATION**  
3 cr. (2 and 2)  
Current issues in early childhood curriculum, their sources and the beliefs supporting them; design of a modified curriculum for a specific content area and level; for graduate students with teaching experience. **Prerequisites:** ED 701 and 740, relevant teaching experience, or permission of instructor.
- ED 841 ADVANCED STUDIES IN THE TEACHING OF SECONDARY SCHOOL ENGLISH**  
3 cr. (3 and 0)  
Methods of teaching secondary school English, based on research and review of current literature.
- ED 842 ADVANCED STUDIES IN THE TEACHING OF SECONDARY SCHOOL MATHEMATICS**  
3 cr. (3 and 0)  
Mathematics education history, research in mathematics education, knowledge of the learner, instructional strategies, materials management and evaluation. **Prerequisite:** ED 426 or permission of instructor.



- ED 843**      **ADVANCED STUDIES IN THE TEACHING OF SECONDARY SCHOOL SCIENCE**  
3 cr. (3 and 0)  
Methods of science teaching theory and practice as shown by current research literature; emphasis on laboratory, inquiry and other student-centered teaching strategies; techniques in science curriculum development; issues in science teaching; science teaching leadership skills. **Prerequisite:** ED 427 or permission of instructor.
- ED 844**      **ADVANCED STUDIES IN THE TEACHING OF SECONDARY SCHOOL SOCIAL STUDIES**  
3 cr. (3 and 0)  
Social studies teaching strategies derived from major theories of learning and contemporary research; curricular issues in social studies education. **Prerequisite:** ED 428 or permission of instructor.
- ED 846**      **THE CURRENT LITERATURE IN ENGLISH EDUCATION**  
3 cr. (3 and 0)  
Research literature in English education; an examination of literature in research methods and curriculum in English teaching. **Prerequisite:** A methods course in English education.
- ED 847**      **THE CURRENT LITERATURE IN MATHEMATICS TEACHING**  
3 cr. (3 and 0)  
Recent literature of mathematics education; examination of literature in both the research and curriculum in secondary mathematics teaching. **Prerequisite:** A graduate teaching methods course or permission of instructor.
- ED 848**      **THE CURRENT LITERATURE IN SCIENCE TEACHING**  
3 cr. (3 and 0)  
Recent literature of science education; examination of literature in both the research and curriculum in secondary science teaching. **Prerequisite:** A graduate teaching methods course or permission of instructor.
- ED 849**      **THE CURRENT LITERATURE IN SOCIAL STUDIES TEACHING**  
3 cr. (3 and 0)  
Recent literature in social studies education; literature in both curriculum and instruction is considered. **Prerequisite:** A graduate teaching methods course or permission of instructor.
- ED 853**      **ADMINISTRATION AND SUPERVISION OF SPECIAL EDUCATION**  
3 cr. (3 and 0)  
Administrative and supervisory practices in initiating, maintaining and expanding special education programs; especially for principals, supervisors and directors of instruction. **Prerequisite:** ED 471/671 or permission of instructor.
- ED 854**      **APPLIED BEHAVIOR ANALYSIS**  
3 cr. (3 and 0)  
Principles underlying behavioral development and application of the principles of behavior analysis to solving academic and social problems of youth with disabilities in classroom settings. **Prerequisites:** Graduate standing and ED 671 or equivalent.
- ED 861**      **ORGANIZATION AND SUPERVISION OF READING PROGRAMS**  
3 cr. (3 and 0)  
Supervisory problems with planning reading programs; analysis of methods and materials of teaching; evaluation of reading programs. **Prerequisite:** ED 762.
- ED 862**      **CLINICAL RESEARCH IN READING**  
3 cr. (3 and 0)  
Reading research and literature; original investigation in such problems as development of reading skills and attitudes, clinical procedures and techniques required. **Prerequisite:** ED 762.
- ED 863**      **PRACTICUM IN READING**  
3 cr. (2 and 2)  
Supervised practicum emphasizing diagnostic and remedial work with readers in public schools. **Prerequisites:** ED 762 and permission of instructor.
- ED 864**      **SPECIAL PROBLEMS IN READING EDUCATION**  
3 cr. (1 and 4)  
Individual study of a specific topic in reading; student is allowed to study a large diversity of topics. **Prerequisites:** ED 759 or 761; and ED 762, 808 and 862; or permission of instructor.
- ED 865**      **ADVANCED DIAGNOSIS AND REMEDIATION IN READING**  
3 cr. (2 and 3)  
Advanced diagnosis and remediation in reading; review of diagnostic instruments and instructional materials. **Prerequisites:** ED 759 or 761 and 762, and/or permission of instructor.
- ED 866**      **THE PSYCHOLOGY OF TEACHING READING**  
3 cr. (3 and 0)  
Psychological basis of reading process; principles applied in teaching reading. **Prerequisite:** ED 759, 761 or permission of instructor.
- ED 867**      **ADVANCED PRACTICUM IN READING**  
3 cr. (2 and 3)  
Diagnosis and remediation testing; remediation; extensive case studies with recommendation for the classroom teacher required. **Prerequisites:** ED 865 and permission of instructor.
- ED 868**      **TEACHING READING THROUGH A LITERATURE EMPHASIS**  
3 cr. (3 and 0)  
Strategies for integrating literature into the traditional reading program. **Prerequisite:** An introductory reading class or equivalent.
- ED 869**      **THE READING-WRITING CONNECTION: AN INTEGRATED APPROACH**  
3 cr. (3 and 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. **Prerequisite:** Basic reading methods course.

- ED 870 SCHOOLING AS A CULTURAL PROCESS**  
3 cr. (3 and 0)  
Critical analysis of the interdependence of schooling and culture. **Prerequisite:** Graduate standing.
- ED 871 INTERPERSONAL AND GROUP RELATIONSHIPS**  
3 cr. (3 and 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.
- ED 872 HISTORY OF AMERICAN EDUCATION**  
3 cr. (3 and 0)  
Analysis of the historical development of educational purpose and the social and cultural forces which shaped that development. **Prerequisite:** Graduate standing.
- ED 875 SEMINAR IN HUMAN GROWTH AND DEVELOPMENT**  
3 cr. (3 and 0)  
Selected topics in human development from any area of the life span; development topics examined for their impacts on the teaching/learning process, administrative processes and/or counseling approaches. **Prerequisites:** ED 701 or equivalent and teaching, counseling or administrative experience.
- ED 876 SEMINAR IN LEARNING THEORY AND ENVIRONMENTS**  
3 cr. (3 and 0)  
Selected topics in learning theory and variables affecting learning environments. Topics vary with student interests and needs and for their impacts on the teaching/learning process, administrative processes and/or counseling approaches. **Prerequisites:** ED 702 or equivalent and classroom, counseling or administrative experience.
- ED 878 EXPERIMENTAL AND NONEXPERIMENTAL RESEARCH METHODS IN EDUCATION II**  
3 cr. (3 and 0)  
Advanced concepts and skills necessary to analyze, conduct and evaluate educational research; nonexperimental, quasi-experimental 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. **Prerequisite:** ED 778, 808 and EX ST 801, or equivalent.
- ED 879 QUALITATIVE RESEARCH IN EDUCATION**  
3 cr. (3 and 0)  
Application of qualitative studies to educational questions; examination of the nature of qualitative research; examination of rationale and applications of qualitative research methods;

particular attention is given to integration of qualitative and quantitative research methods in educational research. **Prerequisite:** ED 778, 878 or equivalent.

- ED 881 INDIVIDUAL TESTING**  
3 cr. (3 and 0)  
Interpretation of Wechsler scales with supervised practice in their administration. **Prerequisites:** ED 701, 702, 808, 809 and permission of instructor.
- ED 884 SCHOOL PSYCHOLOGY**  
3 cr. (3 and 0)  
Roles and function of the school psychologist, legal/ethical issues; planning and evaluating school psychology service delivery systems; specialized practice procedures to evaluate learning and behavior problems. **Prerequisites:** ED 701 or 702, and ED 808 or 809, and permission of instructor.
- ED 889 RESEARCH IN EDUCATION**  
(IN ED 889)  
(AG ED 889)  
3 cr. (3 and 0)  
See AG ED 889 for description.
- ED 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.  
Student participates in a new or existing research project with a faculty member; develops basic skills in a selected research methodology. **Prerequisite:** Advanced methods course, ED 808, 889 or permission of instructor.
- ED 894 DIRECTED RESEARCH**  
1-4 cr. (1-4 and 0)  
Research in a line of inquiry in education under the direction of faculty; a specific educational question is investigated and reported using appropriate methodology. Graded on a pass/fail basis. **Prerequisites:** ED 778, ED 808 or permission of instructor.
- ED 915 INTERNSHIP IN A COUNSELING SETTING**  
3 cr. (1 and 6)  
A postmaster's degree supervised internship in counseling; designed to provide experience in counseling as well as coordination of services for a diverse client population; the student participates in direct services with clients in an approved agency. May be repeated for a total of six hours of credit. **Prerequisite:** A master's degree in counseling or closely related field approved by program coordinator.
- ED 930 ADVANCED STUDIES IN FOUNDATIONS OF SPECIAL EDUCATION**  
3 cr. (3 and 0)  
Historical, psychological and sociological foundations of special education, emphasizing current federal legislation; federal, state, case law and pending litigation impacting special education programming. **Prerequisites:** Graduate standing, EDL 725 and ED 853 or permission of instructor.



- ED 931**      **ADVANCED METHODS AND CURRICULUM DEVELOPMENT IN LEARNING DISABILITIES**  
3 cr. (3 and 0)  
Theory, research and practice pertaining to selected issues in methods and curriculum in the field of learning disabilities, emphasizing the preparation, selection and adaptation of instructional materials for learning-disabled students. **Prerequisites:** Graduate standing, ED 778 and 821 or permission of instructor.
- ED 932**      **ADVANCED METHODS AND CURRICULUM DEVELOPMENT IN EMOTIONALLY HANDICAPPED**  
3 cr. (3 and 0)  
History, research and practice pertaining to effective methods of working with the emotionally handicapped, emphasizing the impact of various theoretical models on curriculum development and intervention. **Prerequisites:** Graduate standing and ED 821.
- ED 933**      **ADVANCED METHODS AND CURRICULUM DEVELOPMENT IN MENTALLY HANDICAPPED**  
3 cr. (3 and 0)  
History, theory, research and practice pertaining to the education of the mentally handicapped, emphasizing the development and implementation of community-based as well as lifespan curricula development. **Prerequisites:** Graduate standing and ED 821.
- ED 934**      **PROGRAM MODELS, EVALUATION AND CURRENT TRENDS IN SPECIAL EDUCATION**  
3 cr. (3 and 0)  
Program models, program evaluation and current trends and issues in programming which impact the future growth of special education. **Prerequisites:** Graduate standing and ED 930.
- ED 954**      **CURRICULUM THEORY**  
3 cr. (3 and 0)  
Main currents of curriculum theory in American education. **Prerequisite:** Ed 760 or 765.
- ED 955**      **THEORETICAL BASES OF INSTRUCTION**  
3 cr. (3 and 0)  
Seminar in the application of learning theory to instructional practice, emphasizing instructional strategies in the classroom. **Prerequisite:** ED 702.
- ED 980**      **INTERNSHIP IN CURRICULUM AND INSTRUCTION**  
1-6 cr. (0 and 3-18)  
Practical experiences linking the student's program of study to his or her field of professional service. Graded on a pass/fail basis. **Prerequisite:** Permission of the student's major advisor.
- ED 991**      **DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

*The following courses are applicable only to the Master of Education degree in secondary education with emphasis in the specific subject areas. Descriptions are under the respective departmental headings.*

### **English**

Martin J. Jacobi, Advisor

- ENGL 700**      **CHILDREN'S LITERATURE FOR TEACHERS**  
3 cr. (3 and 0)
- ENGL 701**      **LITERATURE FOR TEACHERS**  
3 cr. (3 and 0)
- ENGL 702**      **WRITING PROJECTS**  
3 cr. (3 and 0)

### **History and Government**

Edwin E. Moise, Advisor

- ECON 750**      **ECONOMIC CONCEPTS AND CLASSROOM APPLICATIONS FOR TEACHERS**  
3 cr. (3 and 0)
- ECON 751**      **SELECTED TOPICS FOR TEACHERS**  
3 cr. (3 and 0)
- GEOG 700**      **TOPICS IN GEOGRAPHY**  
3 cr. (3 and 0)
- HIST 700**      **UNITED STATES THROUGH THE CIVIL WAR**  
3 cr. (3 and 0)
- HIST 710**      **UNITED STATES SINCE 1865**  
3 cr. (3 and 0)
- HIST 720**      **SOUTHERN HISTORY**  
3 cr. (3 and 0)
- HIST 760**      **BRITISH HISTORY**  
3 cr. (3 and 0)
- HIST 770**      **EUROPE TO THE 18TH CENTURY**  
3 cr. (3 and 0)
- HIST 775**      **EUROPE SINCE THE 18TH CENTURY**  
3 cr. (3 and 0)
- HIST 790**      **HISTORICAL AREA STUDIES**  
3 cr. (3 and 0)

### **Mathematics**

William R. Hare, Advisor

- MTHSC 700**      **MATHEMATICAL COMPUTER APPLICATIONS FOR ELEMENTARY TEACHERS**  
3 cr. (3 and 0)
- MTHSC 703**      **MODERN MATHEMATICS FOR ELEMENTARY SCHOOL TEACHERS — GEOMETRY**  
3 cr. (3 and 0)
- MTHSC 707**      **MATHEMATICS FOR MIDDLE SCHOOL TEACHERS — ALGEBRA**  
3 cr. (3 and 0)



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|-----------|--------------------------------------------------------------------------------|
| MTHSC 709 | <b>MATHEMATICS FOR MIDDLE SCHOOL TEACHERS — GEOMETRY</b><br>3 cr. (3 and 0)    |
| MTHSC 710 | <b>ELEMENTARY CALCULUS FROM AN ADVANCED VIEWPOINT I</b><br>3 cr. (3 and 0)     |
| MTHSC 711 | <b>ELEMENTARY CALCULUS FROM AN ADVANCED VIEWPOINT II</b><br>3 cr. (3 and 0)    |
| MTHSC 712 | <b>MODERN ALGEBRAIC CONCEPTS</b><br>3 cr. (3 and 0)                            |
| MTHSC 719 | <b>DISCRETE MATHEMATICS</b><br>3 cr. (3 and 0)                                 |
| MTHSC 721 | <b>MATRIX ALGEBRA</b><br>3 cr. (3 and 0)                                       |
| MTHSC 723 | <b>APPLICATIONS OF LINEAR AND MODERN ALGEBRA</b><br>3 cr. (3 and 0)            |
| MTHSC 725 | <b>COMBINATORIAL MATHEMATICS FOR TEACHERS</b><br>3 cr. (3 and 0)               |
| MTHSC 727 | <b>ANALYSIS CONCEPTS FOR TEACHERS</b><br>3 cr. (3 and 0)                       |
| MTHSC 730 | <b>MODERN GEOMETRY FOR TEACHERS</b><br>3 cr. (3 and 0)                         |
| MTHSC 732 | <b>PROJECTIVE GEOMETRY</b><br>3 cr. (3 and 0)                                  |
| MTHSC 741 | <b>INTRODUCTION TO LINEAR PROGRAMMING WITH APPLICATIONS</b><br>3 cr. (3 and 0) |
| MTHSC 751 | <b>FUNDAMENTAL CONCEPTS OF CALCULUS</b><br>3 cr. (3 and 0)                     |
| MTHSC 761 | <b>PROBABILITY AND STATISTICS FOR TEACHERS</b><br>3 cr. (3 and 0)              |
| MTHSC 771 | <b>NUMERICAL METHODS IN SECONDARY SCHOOL MATHEMATICS</b><br>3 cr. (3 and 0)    |
| MTHSC 783 | <b>THEORY OF NUMBERS</b><br>3 cr. (3 and 0)                                    |
| MTHSC 791 | <b>SELECTED TOPICS IN MATHEMATICS EDUCATION</b><br>1-3 cr. (1-3 and 0)         |

### *Natural Sciences*

John E. Fairey, Advisor

|           |                                                                  |
|-----------|------------------------------------------------------------------|
| AGRON 701 | <b>SOILS AND MAN</b><br>3 cr. (3 and 0)                          |
| W F B 712 | <b>WILDLIFE CONSERVATION FOR TEACHERS</b><br>2-3 cr. (2-3 and 0) |
| W F B 716 | <b>BIOLOGY OF FISHES FOR TEACHERS</b><br>3 cr. (3 and 0) SS      |

|          |                                                                               |
|----------|-------------------------------------------------------------------------------|
| BIOL 710 | <b>SELECTED TOPICS FOR TEACHERS</b><br>1-6 cr. (0-6 and 0-18)                 |
| CH 700   | <b>PHYSICAL SCIENCE IN ELEMENTARY SCHOOL — CHEMISTRY</b><br>3 cr. (2 and 3) N |
| ENT 700  | <b>ENTOMOLOGY FOR TEACHERS</b><br>3 cr. (2 and 2) SS                          |
| GEN 701  | <b>MODERN DEVELOPMENTS IN GENETICS</b><br>3 cr. (3 and 0)                     |
| GEOL 700 | <b>GEOLOGY FOR SCIENCE TEACHERS</b><br>3 cr. (2 and 3)                        |
| GEOL 740 | <b>EARTH/SPACE SCIENCE FOR ELEMENTARY SCHOOL TEACHERS</b><br>3 cr. (2 and 3)  |
| GEOL 790 | <b>SELECTED TOPICS IN EARTH SCIENCES</b><br>1-6 cr. (0-6 and 0-18)            |
| HORT 701 | <b>HORTICULTURE: PLANT AND ENVIRONMENTAL SCIENCE</b><br>3 cr. (2 and 3) SS    |
| NUTR 706 | <b>NUTRITION FOR TEACHERS</b><br>3 cr. (3 and 0) SS                           |
| PHYS 710 | <b>SELECTED TOPICS FOR TEACHERS</b><br>1-6 cr. (0-6 and 0-18)                 |

*These courses in educational leadership are offered for the doctoral program.*

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| EDL 700 | <b>PUBLIC SCHOOL ADMINISTRATION</b><br>3 cr. (3 and 0)<br>Theoretical bases of school administration; organizational principles, patterns and practices in public schools; decision making; administration of programs and services. <b>Prerequisite:</b> Three graduate education courses or permission of instructor. |
| EDL 705 | <b>THE PRINCIPALSHIP</b><br>3 cr. (3 and 0)<br>Roles and responsibilities of the principalship, including the organization and administration of schools.                                                                                                                                                               |
| EDL 710 | <b>ORGANIZATIONAL THEORY FOR SCHOOL ADMINISTRATORS</b><br>3 cr. (3 and 0)<br>Theory of management, communication, human relations, social systems, motivation, contingency, decision making and change. <b>Prerequisite:</b> EDL 700.                                                                                   |
| EDL 715 | <b>SCHOOL AND COMMUNITY RELATIONSHIPS</b><br>3 cr. (3 and 0)<br>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.          |



- EDL 720 SCHOOL PERSONNEL ADMINISTRATION**  
3 cr. (3 and 0)  
School personnel selection, practices and problems. **Prerequisites:** EDL 700 and 705.
- EDL 725 LEGAL PHASES OF SCHOOL ADMINISTRATION**  
3 cr. (3 and 0)  
Legal principles involved in school administration and in court actions. **Prerequisites:** EDL 700 and 710.
- EDL 730 TECHNIQUES OF SUPERVISION — THE PUBLIC SCHOOLS**  
3 cr. (3 and 0)  
Improving, coordinating and evaluating instruction; modern trends of supervisory practices. **Prerequisites:** EDL 700 and 710.
- EDL 735 EDUCATIONAL EVALUATION**  
3 cr. (3 and 0)  
Evaluation theory and design applied to classroom instruction and to evaluation procedures applicable to school center and district programs and projects. **Prerequisites:** EDL 700 and 710.
- EDL 740 CURRICULUM PLANNING AND IMPROVEMENT FOR SCHOOL ADMINISTRATORS**  
3 cr. (3 and 0)  
Role of leadership in curriculum planning and improvement: curriculum evaluation and development, change, programmatic requirements, co-curriculum, organization, scheduling, planning, management and technology. **Prerequisites:** EDL 700 and 710.
- EDL 745 SCHOOL FINANCE**  
3 cr. (3 and 0)  
School finance relative to programs, revenues and experience. **Prerequisites:** EDL 700 and 735.
- EDL 750 FIELD EXPERIENCE IN ELEMENTARY ADMINISTRATION AND SUPERVISION**  
3 cr. (1 and 4)  
Practicum with an experienced elementary administrator or supervisor. May be repeated for a maximum of six credits. **Prerequisites:** EDL 700 and 710.
- EDL 755 FIELD EXPERIENCE IN SECONDARY ADMINISTRATION AND SUPERVISION**  
3 cr. (1 and 4)  
Practicum with an experienced secondary administrator or supervisor. May be repeated for a maximum of six credits. **Prerequisites:** EDL 700 and 710.
- EDL 760 PROGRAM ADMINISTRATION AND LEADERSHIP IN HIGHER EDUCATION**  
3 cr. (3 and 0)  
Process of organizing the personnel and financial resources needed to meet effectively student development and institutional goals and objectives. **Prerequisite:** Permission of instructor.
- EDL 765 ASSESSMENT IN HIGHER EDUCATION**  
3 cr. (3 and 0)  
Outcomes assessment and institutional effectiveness movement including assessment techniques, instrument selection, analysis of assessment data and reporting of assessment findings. **Prerequisite:** Permission of instructor.
- EDL 800 PHILOSOPHY, SCHOOLING AND EDUCATIONAL POLICY**  
3 cr. (3 and 0)  
Analysis of the development of contemporary educational theory and its impact on current schooling practices and educational policy development.
- EDL 805 ADVANCED EDUCATIONAL LEADERSHIP: THEORY AND PRACTICE**  
3 cr. (3 and 0)  
Accepted principles and theories of leadership as practiced in the institutional setting. **Prerequisites:** EDL 700, 715 and 730.
- EDL 810 INTRODUCTION TO SCHOOL BUILDING PLANNING**  
3 cr. (2 and 2)  
Planning of educational facilities from conception of need through utilization of facility. **Prerequisite:** EDL 700.
- EDL 815 THE SUPERINTENDENCY**  
3 cr. (3 and 0)  
Current, in-depth study of the superintendency, including relationships with school boards, faculty, staff and community, for practicing and aspiring educational administrators. **Prerequisite:** Admission to the educational specialist program or the doctoral program.
- EDL 820 POLITICS OF EDUCATION**  
3 cr. (3 and 0)  
Politics of education in the United States, including the complex interrelationships among administrators, special interest groups, politicians and knowledge brokers.
- EDL 830 BUSINESS MANAGEMENT IN EDUCATION**  
3 cr. (2 and 3)  
Fiscal management of individual schools and districts, including budgeting, purchasing and accounting for funds. **Prerequisites:** EDL 700, 725 and 745.
- EDL 839 RESEARCH METHODS IN EDUCATIONAL LEADERSHIP**  
3 cr. (3 and 0)  
Introductory course for development of the design, method and procedures for conducting the Educational Specialist Project; culmination of the course is the completion and presentation of the project prospectus for approval by the instructor and the student's major advisor. Graded on a pass/fail basis. **Prerequisites:** EDL 800, 805, 820 and permission of instructor.



- EDL 840 FIELD PROBLEMS IN SCHOOL ADMINISTRATION AND SUPERVISION OF INSTRUCTION**  
3 cr. (2 and 3)  
Application of research techniques and practices in solution of field problems in school administration and supervision. **Prerequisites:** EDL 700 and ED 778.
- EDL 850 PRACTICUM IN SCHOOL SYSTEM ADMINISTRATION AND SUPERVISION**  
3 cr. (1 and 4)  
Practicum with an experienced school-system-level administrator or supervisor. May be repeated for a maximum of six credits. **Prerequisites:** EDL 800, 805 and permission of instructor.
- EDL 885 SELECTED TOPICS IN EDUCATIONAL ADMINISTRATION**  
1-3 cr. (1-3 and 0)  
Current literature and results of current research. Topics vary from year to year. May be repeated for a maximum of six credits.
- EDL 890 POLICY AND MANAGEMENT OF SCHOOL DISCIPLINE**  
3 cr. (3 and 0)  
Theory and practice involved in student management and discipline in today's schools, particularly preventative management, organizational variables and today's litigious environment. **Prerequisite:** Permission of instructor.
- EDL 900 PRINCIPLES OF EDUCATIONAL LEADERSHIP**  
3 cr. (3 and 0)  
Advanced leadership theory; the nature of leadership, major theories of leadership, and their application in educational organizations. **Prerequisite:** Must have passed the preliminary examination in the Ph.D. program in educational leadership.
- EDL 905 THEORY AND PRACTICE IN EDUCATIONAL LEADERSHIP**  
3 cr. (3 and 0)  
Advanced organizational and leadership theory; major theories of organization and their applications in understanding the roles of governmental agencies in society. **Prerequisite:** Admission to doctoral studies.
- EDL 910 INTRODUCTORY DOCTORAL SEMINAR**  
3 cr. (3 and 0)  
Educational leadership for beginning doctoral students providing an introduction to the conceptual and theoretical frameworks of educational leadership for both public school administration and higher education administration. **Prerequisite:** Permission of instructor.
- EDL 915 EDUCATIONAL PLANNING**  
3 cr. (3 and 0)  
Education planning, the mechanics of the total planning process, the systems approach to planning and management, and the measurement and interpretation of performance results.
- EDL 925 INSTRUCTIONAL LEADERSHIP**  
3 cr. (3 and 0)  
Preparation for a career in educational leadership; the principal's functions regarding the effective school's movement as incorporated in instructional leadership.
- EDL 950 EDUCATIONAL POLICY STUDIES**  
3 cr. (3 and 0)  
Critical analysis of the sources and nature of educational policy and how policy is developed, administered and assessed for public schools. **Prerequisite:** Admission to doctoral studies.
- EDL 955 (VT ED 955) THE TWO-YEAR COLLEGE**  
3 cr. (3 and 0)  
Historical developments, functions, organization and administration of the two-year college. **Prerequisite:** Admission to doctoral studies or permission of instructor.
- EDL 960 LEGAL PRINCIPLES IN THE ADMINISTRATION OF INSTITUTIONS OF HIGHER EDUCATION**  
3 cr. (3 and 0)  
General principles of higher education law from the points of view of statute and common law practice. **Prerequisite:** Admission to doctoral studies or permission of instructor.
- EDL 970 FOUNDATIONS OF HIGHER EDUCATION**  
3 cr. (3 and 0)  
Survey of American higher education including its historical, political, philosophical and social aspects. **Prerequisite:** Admission to doctoral studies.
- EDL 976 EXTERNAL EFFECTIVENESS IN HIGHER EDUCATION**  
3 cr. (3 and 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.
- EDL 980 CURRENT ISSUES IN EDUCATIONAL LEADERSHIP**  
1-3 cr. (1-3 and 0)  
Topics and issues as determined by the needs of the students and the instructor. **Prerequisite:** Graduate status and permission of instructor.
- EDL 985 INTERNSHIP IN EDUCATIONAL LEADERSHIP**  
3 cr. (1 and 4)  
Experience working in a chosen area of specialization in educational leadership, either in public schools or institutions of higher education; experience planned to build competence in the student's field of specialization. May be repeated for a maximum of six credits. Graded on a pass/fail basis. **Prerequisites:** EDL 900, 905 and 910 and permission of major advisor.



- EDL 989 ADVANCED DOCTORAL SEMINAR I**  
3 cr. (3 and 0)  
Exploration of educational leadership topics; culminates in selection of topic for presentation and approval and development of Chapter I of a prospectus. **Prerequisites:** EDL 900, 905, 910 and permission of instructor.
- EDL 990 ADVANCED DOCTORAL SEMINAR II**  
3 cr. (3 and 0)  
Seminar for advanced students, focusing on the preparation of dissertation Chapters I-III.
- EDL 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.
- EDL 995 DIRECTED RESEARCH**  
1-4 cr. (1-4 and 0)  
Research option for graduate students to pursue a line of inquiry in education under the direction of faculty; specific educational question is investigated and reported using appropriate methodology. May be repeated for a total of four credits. Graded on a pass/fail basis. **Prerequisite:** Admission to doctoral studies or permission of instructor.

*These courses in coaching education are offered by the Department of Curriculum and Instruction for recertification or as electives.*

- C ED 653 ATHLETIC INJURIES: PREVENTION, ASSESSMENT AND REHABILITATION**  
3 cr. (3 and 0)
- C ED 721 SPORT LAW**  
3 cr. (3 and 0)  
Legal principles involved in school sports programs and in court action. **Prerequisites:** C ED 761 and three graduate courses in C ED or permission of instructor.
- C ED 751 PHYSIOLOGY OF TRAINING THE ATHLETE**  
3 cr. (3 and 0)  
Specific sport skill training; emphasis is on the design of exercise programs for the particular sport.
- C ED 752 ADVANCED SKILL ANALYSIS IN SPORTS**  
3 cr. (3 and 0)  
Application of the basic laws of physics to human movement; student uses videotapes to break down sports skill and make recommendations for improvement.
- C ED 761 ORGANIZATION AND ADMINISTRATION OF PHYSICAL EDUCATION AND ATHLETIC PROGRAMS**  
3 cr. (3 and 0)  
Policies and procedures of administration on the secondary and collegiate levels; special emphasis on construction and care of facilities, equipment and personnel.
- C ED 762 PSYCHOLOGICAL BASIS OF COACHING**  
3 cr. (3 and 0)  
Psychological theory and techniques that enhance the performance and personal growth of athletes from youth sports to the elite levels.

- C ED 765 PRACTICUM I IN COACHING EDUCATION**  
3 cr. (1 and 6)  
Application of theoretical concepts in real athletic/sports administration situations for coaches. **Prerequisites:** C ED 751 and 761, ED 778 and permission of instructor.
- C ED 766 PRACTICUM II IN COACHING EDUCATION**  
3 cr. (1 and 6)  
Application of theoretical concepts in real athletic/sports administration situations for coaches. **Prerequisites:** C ED 751, 761 and 765, ED 778 and permission of instructor.

*These courses are offered by the School of Education.*

- COLED 680 (ED 680) (AG ED 680) (IN ED 680) EDUCATIONAL APPLICATIONS OF MICROCOMPUTERS**  
3 cr. (3 and 0)
- COLED 682 (ED 682) (AG ED 682) (IN ED 682) ADVANCED EDUCATIONAL APPLICATIONS OF MICROCOMPUTERS**  
3 cr. (2 and 2)
- H R D 610 (IN ED 610) (G C 610) SELECTED TOPICS**  
1-3 cr. (1-3 and 0)
- H R D 830 CONCEPTS OF HUMAN RESOURCE DEVELOPMENT**  
3 cr. (3 and 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. **Prerequisite:** Permission of instructor.
- H R D 845 (IN ED 845) NEEDS ASSESSMENT FOR EDUCATION AND INDUSTRY**  
3 cr. (3 and 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. **Prerequisite:** H R D 830 or permission of instructor.
- H R D 846 (IN ED 846) APPLIED PUBLIC RELATIONS**  
3 cr. (3 and 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. **Prerequisites:** Employment or ready access to an employer and place of employment; IN ED 496/696 is desirable.



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| <b>H R D 847</b><br><b>(IN ED 847)</b> | <b>INSTRUCTIONAL SYSTEMS DESIGN</b><br>3 cr. (3 and 0)<br>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. <b>Prerequisites:</b> H R D 830 and 845 or permission of instructor.      | <b>IN ED 605</b>                                                                | <b>COURSE ORGANIZATION AND EVALUATION</b><br>3 cr. (3 and 0)                            |
| <b>H R D 849</b>                       | <b>EVALUATION OF TRAINING AND DEVELOPMENT/HRD PROGRAMS</b><br>3 cr. (3 and 0)<br>Theory and practice of evaluation processes related to training and development in human resource development (HRD) 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. <b>Prerequisites:</b> H R D 830, 845, 847, 860 and IN ED 889 or permission of instructor.                     | <b>IN ED 607</b>                                                                | <b>ARCHITECTURAL DRAFTING FOR INDUSTRIAL EDUCATION</b><br>3 cr. (1 and 6)               |
| <b>H R D 860</b><br><b>(IN ED 860)</b> | <b>INSTRUCTIONAL MATERIALS DEVELOPMENT</b><br>3 cr. (3 and 0)<br>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. <b>Prerequisites:</b> H R D 830 and 845.                                                                                                                                              | <b>IN ED 608</b>                                                                | <b>CONDUCTING AND EVALUATING TRAINING PROGRAMS FOR INDUSTRY</b><br>3 cr. (3 and 0)      |
| <b>H R D 870</b><br><b>(IN ED 870)</b> | <b>CONSULTING FOR EDUCATION AND INDUSTRY</b><br>3 cr. (3 and 0)<br>Theory and practice of external and internal consulting practices in human resource development (HRD) 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. <b>Prerequisite:</b> H R D 830 or permission of instructor. | <b>IN ED 610</b><br><b>(G C 610)</b><br><b>(H R D 610)</b>                      | <b>SELECTED TOPICS</b><br>1-3 cr. (1-3 and 0)                                           |
| <b>H R D 897</b>                       | <b>APPLIED RESEARCH AND DEVELOPMENT</b><br>3 cr. (3 and 0)<br>Study of a particular topic under the direction of a faculty member; students identify a special problem related to the human resource development (HRD) profession based on their personal interests, experiences, needs and goals. <b>Prerequisites:</b> Submission of a written proposal, prior approval of advisor and satisfactory completion of 12 hours of graduate HRD courses and IN ED 889.                                                                               | <b>IN ED 612</b>                                                                | <b>COMMUNICATIONS TECHNOLOGY II: SYSTEMS</b><br>3 cr. (2 and 2)                         |
| <b>IN ED 604</b>                       | <b>DEVELOPING TRAINING PROGRAMS FOR INDUSTRY</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>IN ED 614</b>                                                                | <b>ELECTRONICS FOR TEACHERS</b><br>3 cr. (1 and 6)                                      |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>IN ED 615</b>                                                                | <b>CONSTRUCTION TECHNOLOGY II: PRACTICES AND SYSTEMS</b><br>3 cr. (2 and 3)             |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>IN ED 618</b>                                                                | <b>MANUFACTURING TECHNOLOGY II: MATERIALS AND PROCESSES</b><br>3 cr. (2 and 3)          |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>IN ED 622</b>                                                                | <b>HISTORY AND PHILOSOPHY OF INDUSTRIAL AND VOCATIONAL EDUCATION</b><br>3 cr. (3 and 0) |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>IN ED 624</b>                                                                | <b>SCHOOL SAFETY</b><br>3 cr. (3 and 0)                                                 |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>IN ED 625</b>                                                                | <b>TEACHING INDUSTRIAL SUBJECTS</b><br>3 cr. (3 and 0)                                  |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>IN ED 640</b>                                                                | <b>CONTEMPORARY TECHNOLOGICAL PROBLEMS</b><br>3 cr. (3 and 0)                           |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>IN ED 642</b>                                                                | <b>COMPETENCY TESTING IN VOCATIONAL SUBJECTS</b><br>3 cr. (3 and 0)                     |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>IN ED 652</b>                                                                | <b>ADVANCED PROJECTS</b><br>1-6 cr.                                                     |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>IN ED 664</b>                                                                | <b>STILL MEDIA PRODUCTION</b><br>3 cr. (1 and 4)                                        |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>IN ED 665</b>                                                                | <b>INSTRUCTIONAL VIDEO PRODUCTION</b><br>3 cr. (1 and 4)                                |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>IN ED 668</b>                                                                | <b>POWER TECHNOLOGY II: TRANSMISSION AND CONTROL SYSTEMS</b><br>3 cr. (2 and 2)         |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>IN ED 670</b>                                                                | <b>INTERNAL COMBUSTION ENGINES</b><br>3 cr. (2 and 3)                                   |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>IN ED 680</b><br><b>(ED 680)</b><br><b>(COLED 680)</b><br><b>(AG ED 680)</b> | <b>EDUCATIONAL APPLICATIONS OF MICROCOMPUTERS</b><br>3 cr. (3 and 0)                    |



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| <b>IN ED 682</b><br><b>(ED 682)</b><br><b>(COLED 682)</b><br><b>(AG ED 682)</b> | <b>ADVANCED EDUCATIONAL APPLICATIONS OF MICROCOMPUTERS</b><br>3 cr. (2 and 2)                                                                                                                                                                                                                | <b>IN ED 853</b>                                           | <b>CURRENT TOPICS IN CONSTRUCTION TECHNOLOGY</b><br>1-3 cr. (1-3 and 0)<br>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; emphasis is on contemporary technological processes in construction industries. |
| <b>IN ED 696</b>                                                                | <b>PUBLIC RELATIONS</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                   | <b>IN ED 854</b>                                           | <b>CURRENT TOPICS IN POWER TECHNOLOGY</b><br>1-3 cr. (1-3 and 0)<br>Contemporary applications of power and energy for public school teachers and industry personnel.                                                                                                                                                                                                      |
| <b>IN ED 700</b><br><b>(ED 700)</b>                                             | <b>SUPERVISING THE STUDENT TEACHER IN THE PUBLIC SCHOOL</b><br>2-3 cr. (2-3 and 0)<br>See ED 700 for description.                                                                                                                                                                            | <b>IN ED 860</b><br><b>(H R D 860)</b>                     | <b>INSTRUCTIONAL MATERIALS DEVELOPMENT</b><br>3 cr. (3 and 0)<br>See H R D 860 for description.                                                                                                                                                                                                                                                                           |
| <b>IN ED 815</b>                                                                | <b>SEMINAR IN INDUSTRIAL EDUCATION</b><br>1 cr. (1 and 0)<br>Students and faculty discuss and study new technological and professional advances. May be taken up to three times. Graded on a pass/fail basis.                                                                                | <b>IN ED 865</b>                                           | <b>AMERICAN INDUSTRIES</b><br>3 cr. (3 and 0)<br>Concepts and principles of American industry and technology; industrial plant visits supplement study of industrial organization, economics, management, production and products.                                                                                                                                        |
| <b>IN ED 820</b>                                                                | <b>RECENT PROCESS DEVELOPMENTS</b><br>3 cr. (3 and 0)<br>Recent technological innovations, inventions, processes and products, and their impact on our industrial, labor, educational and social institutions.                                                                               | <b>IN ED 870</b><br><b>(H R D 870)</b>                     | <b>CONSULTING FOR EDUCATION AND INDUSTRY</b><br>3 cr. (3 and 0)<br>See H R D 870 for description.                                                                                                                                                                                                                                                                         |
| <b>IN ED 840</b>                                                                | <b>SCHOOL SHOP DESIGN</b><br>3 cr. (3 and 0)<br>All aspects of unit shops, general shops and comprehensive shops for schools offering vocational industrial subjects and industrial arts courses.                                                                                            | <b>IN ED 889</b><br><b>(ED 889)</b><br><b>(AG ED 889)</b>  | <b>RESEARCH IN EDUCATION</b><br>3 cr. (3 and 0)<br>See AG ED 889 for description.                                                                                                                                                                                                                                                                                         |
| <b>IN ED 845</b><br><b>(H R D 845)</b>                                          | <b>NEEDS ASSESSMENT FOR EDUCATION AND INDUSTRY</b><br>3 cr. (3 and 0)<br>See H R D 845 for description.                                                                                                                                                                                      | <b>IN ED 894</b>                                           | <b>PROJECT RESEARCH</b><br>1-6 cr. (1-6 and 0)<br>Research related to departmental projects. Open only to students planning to pursue advanced graduate study. Joint use with IN ED 895, 896 not permitted for degree.                                                                                                                                                    |
| <b>IN ED 846</b><br><b>(H R D 846)</b>                                          | <b>APPLIED PUBLIC RELATIONS</b><br>3 cr. (3 and 0)<br>See H R D 846 for description.                                                                                                                                                                                                         | <b>IN ED 895</b><br><b>(G C 895)</b>                       | <b>SPECIAL PROBLEMS I</b><br>3 cr. (3 and 0)<br>Special problems in industrial education, varying with interests, experiences and needs of students. <b>Prerequisites:</b> Submission of a written proposal, prior approval of advisor and completion of nine hours in the major.                                                                                         |
| <b>IN ED 847</b><br><b>(H R D 847)</b>                                          | <b>INSTRUCTIONAL SYSTEMS DESIGN</b><br>3 cr. (3 and 0)<br>See H R D 847 for description.                                                                                                                                                                                                     | <b>IN ED 896</b><br><b>(G C 896)</b>                       | <b>SPECIAL PROBLEMS II</b><br>3 cr. (3 and 0)<br>Continuation of IN ED 895. <b>Prerequisites:</b> Submission of a written proposal, prior approval of advisor and completion of IN ED 895.                                                                                                                                                                                |
| <b>IN ED 850</b>                                                                | <b>ISSUES IN INDUSTRIAL TECHNOLOGY</b><br>1-3 cr. (1-3 and 0)<br>Industrial technology for public school teachers and individuals employed in business and industry; emphasis is on emerging technologies and innovations in instructional strategies. <b>Prerequisite:</b> Graduate status. | <b>G C 606</b>                                             | <b>PROBLEMS IN SPECIALTY PRINTING</b><br>4 cr. (2 and 6)                                                                                                                                                                                                                                                                                                                  |
| <b>IN ED 851</b>                                                                | <b>CURRENT TOPICS IN COMMUNICATION TECHNOLOGY</b><br>1-3 cr. (1-3 and 0)<br>Recent technological processes in the communication industry, such as CAD, desktop publishing and interactive video, for teachers and industrial personnel. <b>Prerequisite:</b> Graduate status.                | <b>G C 607</b>                                             | <b>ADVANCED FLEXOGRAPHIC METHODS</b><br>4 cr. (2 and 6)                                                                                                                                                                                                                                                                                                                   |
| <b>IN ED 852</b>                                                                | <b>CURRENT TOPICS IN MANUFACTURING TECHNOLOGY</b><br>1-3 cr. (1-3 and 0)<br>Contemporary manufacturing practices for public school teachers and industry personnel.                                                                                                                          | <b>G C 610</b><br><b>(IN ED 610)</b><br><b>(H R D 610)</b> | <b>SELECTED TOPICS</b><br>1-3 cr. (1-3 and 0)                                                                                                                                                                                                                                                                                                                             |



- G C 640**      **ADVANCED LITHOGRAPHIC METHODS**  
5 cr. (2 and 9)
- G C 644**      **CURRENT DEVELOPMENTS AND TRENDS  
IN GRAPHIC COMMUNICATIONS**  
4 cr. (2 and 6)
- G C 645**      **ADVANCED SCREEN PRINTING METHODS**  
3 cr. (2 and 3)
- G C 646**      **INK AND SUBSTRATES**  
3 cr. (2 and 3)
- G C 648**      **PLANNING AND CONTROLLING PRINTING  
FUNCTIONS**  
3 cr. (3 and 0)
- G C 801**      **PROCESS CONTROL IN COLOR  
REPRODUCTION**  
3 cr. (2 and 3)  
Emphasis on 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, flexographic, gravure and screen printing processes. **Prerequisite:** G C 444 or equivalent.
- G C 895**      **SPECIAL PROBLEMS I**  
(IN ED 895)      3 cr. (3 and 0)  
See IN ED 895 for description.
- G C 896**      **SPECIAL PROBLEMS II**  
(IN ED 896)      3 cr. (3 and 0)  
See IN ED 896 for description.
- VT ED 810**      **FOUNDATIONS OF VOCATIONAL AND  
TECHNICAL EDUCATION**  
3 cr. (3 and 0)  
Evolution of vocational and technical education during the twentieth 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 cr. (3 and 0)  
National, state and local legislation governing financial support of vocational/technical programs; development of budget, audit, and financial administrative plans and systems. **Prerequisites:** VT ED 810 and EDL 745 or equivalent.
- VT ED 833**      **CURRICULUM CONSTRUCTION IN  
VOCATIONAL AND TECHNICAL  
EDUCATION**  
3 cr. (3 and 0)  
Students develop a specific course in a selected vocational and technical education area by specifying performance goals and building around these objectives. **Prerequisite:** AG ED 640 or IN ED 605 or equivalent.

- VT ED 850**      **PROGRAMS, CONCEPTS AND ISSUES IN  
VOCATIONAL AND TECHNICAL  
EDUCATION**  
3 cr. (3 and 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 cr. (3 and 0)  
Principles and practices for administering and supervising vocational and technical schools and classes under federal vocational acts, state regulations and local policies. **Prerequisite:** VT ED 810 or permission of instructor.
- VT ED 876**      **COLLEGE TEACHING**  
3 cr. (3 and 0)  
Instructional practices; curriculum; techniques of organizing and planning learning experiences; analysis of teaching strategies and systems.
- VT ED 882**      **SEMINAR**  
1 cr. (1 and 0)  
Current issues and problems and proposed research projects.
- VT ED 893**      **ADVANCED RESEARCH DESIGN AND  
ANALYSIS**  
3 cr. (3 and 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. **Prerequisite:** AG ED 889 or equivalent.
- VT ED 955**      **THE TWO-YEAR COLLEGE**  
(EDL 955)      3 cr. (3 and 0)  
See EDL 955 for description.
- VT ED 980**      **INTERNSHIP IN VOCATIONAL/TECHNICAL  
EDUCATION**  
1-6 cr. (0 and 3-18)  
Internship in which the student gains 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. Graded on a pass/fail basis. **Prerequisite:** Permission of the student's major advisor.
- VT ED 991**      **DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.



**School of Health and Social Sciences**

Applied Sociology  
 School of Nursing  
 Political Science  
 Psychology  
 Public Health

**Applied Sociology**

John W. Ryan, Chair, Department of Sociology

| Major             | Degree |
|-------------------|--------|
| Applied Sociology | M.S.   |

Applicants for the M.S. degree must hold a bachelor's degree from an accredited degree program; have completed a minimum of 15 undergraduate semester hours in sociology or other social science discipline that includes at least one course each in statistics, research, methods and sociological theory; submit Graduate Record Examinations scores on the verbal, quantitative and analytical sections (satisfactory scores normally include a minimum of 500 on each section of the test); submit three letters of recommendation; and submit a 500-word essay on career aspirations and goals and how completion of this program in applied sociology will assist in achieving these goals.

All students are required to write a thesis and to complete a minimum of 40 hours of course work and selected electives. Students must demonstrate competence in basic statistics in the first semester by either passing a departmentally administered competency examination or obtaining a grade of B in EX ST 801. Students also must demonstrate competency in multivariate regression in the second semester by either passing a departmentally administered competency examination or obtaining a grade of B in MTHSC 805. The 40-hour requirement includes a six-hour field placement in an applied setting, which 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 year of the program but only after completing a minimum of 12 credit hours of 800-level course work. In exceptional circumstances the graduate coordinator may approve the substitution of six hours of appropriate course work for the field placement when the student has had work experience comparable to the placement.

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| <b>SOC 601</b><br><b>(R S 601)</b> | <b>HUMAN ECOLOGY</b><br>3 cr. (3 and 0) S                     |
| <b>SOC 604</b>                     | <b>SOCIOLOGICAL THEORY</b><br>3 cr. (3 and 0)                 |
| <b>SOC 630</b>                     | <b>SOCIOLOGY OF ORGANIZATIONS</b><br>3 cr. (3 and 0)          |
| <b>SOC 633</b>                     | <b>DEVELOPING SOCIETIES</b><br>3 cr. (3 and 0)                |
| <b>SOC 640</b>                     | <b>LEISURE, THE MASS MEDIA AND CULTURE</b><br>3 cr. (3 and 0) |
| <b>SOC 641</b>                     | <b>SOCIOLOGY OF SPORT</b><br>3 cr. (3 and 0)                  |
| <b>SOC 659</b><br><b>(R S 659)</b> | <b>THE COMMUNITY</b><br>3 cr. (3 and 0) F                     |
| <b>SOC 660</b>                     | <b>RACE, ETHNICITY AND CLASS</b><br>3 cr. (3 and 0)           |
| <b>SOC 662</b>                     | <b>MEN, MASCULINITY AND SOCIETY</b><br>3 cr. (3 and 0)        |

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| <b>SOC 663</b>                     | <b>SOCIOLOGY OF PARENTING</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                |
| <b>SOC 671</b><br><b>(R S 671)</b> | <b>DEMOGRAPHY</b><br>3 cr. (3 and 0) F                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>SOC 680</b>                     | <b>MEDICAL SOCIOLOGY</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>SOC 681</b>                     | <b>AGING AND DEATH</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>SOC 684</b>                     | <b>CHILD ABUSE AND TREATMENT</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                             |
| <b>SOC 803</b>                     | <b>SURVEY DESIGNS FOR APPLIED SOCIAL RESEARCH</b><br>3 cr. (3 and 0) F<br>Survey research design principles, procedures and techniques used in applied sociology; emphasis is on instrumentation, data collection and management, and their interpretation.<br><b>Prerequisite:</b> SOC 303 or equivalent.                                                                                                                      |
| <b>SOC 805</b>                     | <b>EVALUATION RESEARCH</b><br>3 cr. (3 and 0) S<br>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; special emphasis is on microcomputer software packages available for these purposes. <b>Prerequisite:</b> SOC 803.                                            |
| <b>SOC 807</b>                     | <b>ADVANCED RESEARCH METHODS</b><br>3 cr. (3 and 0) S<br>Advanced methods in social research; consideration of various measuring techniques and data analysis strategies; practical experience in various phases of social research. <b>Prerequisite:</b> SOC 803.                                                                                                                                                              |
| <b>SOC 810</b>                     | <b>THEORETICAL MODELS IN APPLIED SOCIAL RESEARCH</b><br>3 cr. (3 and 0) S<br>Comparative analysis of theoretical models in sociology and their uses in applied research; particular attention is given to the uses of these models in research concerned with the processes of industrial and economic growth and development. <b>Prerequisite:</b> SOC 404 or equivalent.                                                      |
| <b>SOC 812</b>                     | <b>SEMINAR ON MARRIAGE AND THE FAMILY</b><br>3 cr. (3 and 0) N<br>Current family research and theory in areas such as problem-solving strategies, developmental processes, family and work life, changes throughout the lifespan, including premarital sexuality, pregnancy, divorce, marriage enrichment and courtship. Topics vary from year to year. May be repeated for credit. <b>Prerequisite:</b> SOC 311 or equivalent. |
| <b>SOC 814</b>                     | <b>POLICY AND SOCIAL ACTION</b><br>3 cr. (3 and 0) N<br>Policy formation, implementation and evaluation in public and private sectors with a focus                                                                                                                                                                                                                                                                              |



on outcomes of policy formation, social planning and implementation. **Prerequisite:** SOC 810 or permission of instructor.

- SOC 830 HUMAN SYSTEMS DEVELOPMENT: ORGANIZATIONS AND SOCIETY**  
3 cr. (3 and 0) F  
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. **Prerequisite:** SOC 430 or equivalent.
- SOC 833 WORK AND SOCIETY**  
3 cr. (3 and 0) S  
The history of industrial development and its consequences at the societal, community and individual levels; current issues involved in the relationship between work and society, and strategies for developing research and policy related to these issues. **Prerequisite:** SOC 330 or equivalent.
- SOC 835 SEMINAR ON WORK, LEISURE AND THE FAMILY**  
3 cr. (3 and 0) N  
Current topics and research on work, leisure and the family. Topics vary from year to year. May be repeated for credit. **Prerequisite:** SOC 830 or 833.
- SOC 882 SYSTEMS OF MARITAL AND FAMILY THERAPY**  
3 cr. (3 and 0)  
Theories and techniques of marital and family therapy. **Prerequisite:** Permission of instructor.
- SOC 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- SOC 892 SELECTED TOPICS IN SOCIOLOGY**  
3 cr. (3 and 0) N  
Current topics in applied sociology not covered in other graduate courses. May be repeated once for credit.
- SOC 895 FIELD EXPERIENCE**  
3-6 cr. SS  
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. Graded on a pass/fail basis. **Prerequisite:** 12 hours of 800-level course work in sociology.
- SOC 896 INDEPENDENT STUDY**  
1-3 cr. (1-3 and 0)  
Individual readings or research in a topic area selected according to a student's interests or program needs. May be repeated for up to six hours. Graded on a pass/fail basis. **Prerequisite:** Approval of the director of graduate studies.
- ANTH 603 QUALITATIVE METHODS**  
3 cr. (3 and 0)

## School of Nursing

Barbara Logan, Director, School of Nursing

**Major**  
Nursing

**Degree**  
M.S.

The School of Nursing offers an advanced degree in nursing. Courses are offered in health to provide electives for students in other areas.

In addition to meeting University admission requirements, applicants should be graduates of baccalaureate programs accredited by the National League for Nursing. Under unusual circumstances, this requirement may be waived by the director of the School of Nursing. The applicants must also be licensed to practice professional nursing in the state(s) in which they do their clinical practice and carry professional liability insurance.

Health assessment is a prerequisite to enrollment in the graduate program. A thesis or nonthesis option is available. Normally, 37 semester credit hours are required for awarding the Master of Science degree; 43 semester credit hours are required for the Family Nurse Practitioner emphasis with the nonthesis option, and 46 hours with the thesis option.

- NURS 671 HOLISTIC APPROACHES TO HEALTH**  
3 cr. (3 and 0)
- NURS 801 ADVANCED FAMILY NURSING**  
3 cr. (3 and 0)  
Developmental, psychodynamic, social-political, and cultural theories and concepts synthesized and applied to the analysis of health and illness in families across the life cycle; roles and functions of advanced practice nurses in promoting family health.
- NURS 802 ADVANCED LEADERSHIP AND ROLE**  
3 cr. (3 and 0)  
Introduction to the advanced roles of educator, administrator and clinical specialist in nursing; leadership theory/models and practices; leadership functions of program planning and evaluation, and health policy formation.
- NURS 804 KNOWLEDGE DEVELOPMENT IN ADVANCED NURSING**  
2 cr. (2 and 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 cr. (3 and 0)  
Prescription, administration and patient/family education in use of pharmacological agents, emphasizing the drugs prescribed for common or chronic illnesses, particularly drug selection, adverse drug reactions, age-related differences in utilization and regulations affecting the nurse's prescriptive authority. **Prerequisite or Corequisite:** NURS 809.



- NURS 806 ADVANCED ASSESSMENT FOR NURSING**  
2 cr. (1 and 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. **Prerequisites or Corequisites:** NURS 801 and 809.
- NURS 807 CLINICAL NURSING RESEARCH**  
2 cr. (2 and 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.
- NURS 808 NURSING RESEARCH ANALYSIS**  
2 cr. (2 and 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. **Prerequisite:** Undergraduate statistics course.
- NURS 809 PATHOPHYSIOLOGY FOR ADVANCED NURSING**  
2 cr. (2 and 0)  
Human response to health problems and illness from the nursing perspective, focusing on the conceptual approach to pathophysiologic phenomena.
- NURS 811 ADVANCED NURSING AND HEALTH POLICY**  
2 cr. (1 and 3)  
Reciprocal influence of nursing, client health and policy making on the delivery of health care; laboratory experience incorporates a variety of directed activities related to the policy process. **Prerequisites:** NURS 801, 805 and 809.
- NURS 812 THE DYNAMICS OF COMMUNITY HEALTH**  
3 cr. (3 and 0)  
Relation of family health to community; epidemiological appraisal of community health; significance of process in planning and decision making; values guiding use and availability of health resources.
- NURS 819 FAMILY NURSING I: DEVELOPING FAMILIES**  
4 cr. (2 and 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. **Prerequisites:** NURS 801, 805, 806 and 809.
- NURS 820 FAMILY NURSING II: CHILD AND ADOLESCENT**  
4 cr. (2 and 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 used to assess, diagnose, intervene and promote continuity of care with clients of these ages irrespective of setting. **Prerequisites:** NURS 801, 805, 806 and 809.
- NURS 821 FAMILY NURSING III: ADULT**  
4 cr. (2 and 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 occurs in a variety of settings. **Prerequisites:** NURS 801, 805, 806 and 809.
- NURS 822 FAMILY NURSING IV: GERONTOLOGY**  
4 cr. (2 and 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. **Prerequisites:** NURS 801, 805, 806 and 809.
- NURS 823 PRACTICUM IN ADVANCED FAMILY NURSING**  
6 cr. (0 and 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. **Prerequisites:** NURS 819, 820, 821 and 822.
- NURS 825 THEORIES AND MODELS OF NURSING ADMINISTRATION**  
3 cr. (3 and 0)  
Identification, analysis and synthesis of theories, models and issues related to nursing management and leadership; organization, attitudes and practices applicable to the middle and executive levels of nursing administration. **Prerequisite:** NURS 835, 837, 840 or 861.
- NURS 826 ADMINISTRATION OF NURSING SERVICES**  
3 cr. (2 and 3)  
Application of theories and models to specific nursing administration issues and problems; practicum in nursing administration at the middle or executive level permits specific use and evaluation of a conceptual model of nursing administration. **Prerequisite:** NURS 825. **Corequisite:** NURS 836, 838, 841 or 862.
- NURS 827 FOUNDATIONS OF NURSING EDUCATION**  
3 cr. (3 and 0)  
Exploration of the foundations of nursing education with emphasis on curriculum development in nursing; current issues and research which influence nursing education. **Prerequisite:** NURS 835, 837, 840 or 861.



- NURS 828 THE NURSE EDUCATOR**  
3 cr. (2 and 3)  
Continuation of NURS 827; major focus on teaching in nursing education programs; course development and selection of learning experiences; current issues and research in classroom and clinical teaching; a teaching practicum is required. **Prerequisite:** NURS 827. **Corequisite:** NURS 836, 838, 841 or 862.
- NURS 829 THEORIES AND MODELS OF CLINICAL SPECIALIZATION**  
3 cr. (3 and 0)  
The 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. **Prerequisite:** NURS 835, 837, 840 or 861.
- NURS 830 CLINICAL SPECIALTY PRACTICUM IN NURSING**  
3 cr. (1 and 6)  
Advanced practice in a selected clinical specialty area in nursing that emphasizes application of the clinical specialist role. **Prerequisite:** NURS 829.
- NURS 831 CLINICAL PROBLEMS IN ADVANCED NURSING**  
3 cr. (3 and 0)  
Critical thinking and knowledge of methodologies for scientific inquiry applied to clinical issues/problems encountered in advanced nursing practice. **Prerequisites:** NURS 804, 807 and 808. **Corequisites:** NURS 819, 820, 821 and 822.
- NURS 833 REHABILITATIVE NURSING**  
6 cr. (3 and 9)  
Advanced concepts, principles and theories basic to humanistic practice of professional rehabilitative nursing; repatterning as an integral part of the human development process; clinical laboratory experience selected from rehabilitation, ambulatory and community settings. **Prerequisites:** NURS 801, 804, 807 and 812.
- NURS 835 ADVANCED NURSING OF DEVELOPING CHILDREN**  
5 cr. (3 and 6)  
Analysis of physiological, psychological, sociocultural, developmental and family theories, issues and research that form the basis for nursing practice with families who have healthy children within the developmental levels of birth through adolescence; interventions related to achieving and maintaining optimal health, growth and development incorporated into advanced clinical practice. **Prerequisites or Corequisites:** NURS 802, 804 and 807.
- NURS 836 ADVANCED NURSING OF CHILDREN WITH HEALTH DEFICITS**  
5 cr. (3 and 6)  
Effects of health deficits, separation and hospitalization on children and their families; nursing concerns, issues, management and research related to ill or disabled children; adjudication of expanding nursing roles incorporated into advanced clinical practice. **Prerequisite:** NURS 835.
- NURS 837 ADVANCED NURSING OF CHILDBEARING FAMILIES**  
5 cr. (3 and 6)  
Theories and advanced concepts related to nursing management in the care of healthy childbearing families; major physiological, psychological and sociological changes related to antepartum, intrapartum, postpartum and neonate, incorporated into advanced clinical practice; related nursing issues and current research. **Prerequisites or Corequisites:** NURS 802, 804 and 807.
- NURS 838 ADVANCED NURSING OF CHILDBEARING FAMILIES AT RISK**  
5 cr. (3 and 6)  
Care of childbearing families at risk for complications in physical, socioenvironmental and psychological development; nursing concerns, issues, management and research related to care of the high-risk childbearing family, incorporated into advanced clinical practice. **Prerequisite:** NURS 837.
- NURS 840 ADVANCED GERONTOLOGICAL NURSING I**  
5 cr. (3 and 6)  
Critical, comprehensive overview of research, knowledge, concepts and issues basic to the advanced practice of nursing care of older adults; phenomenon of human aging as reflected by changes in elders' patterns of living; clinical experiences scheduled from a variety of health care settings. **Prerequisites or Corequisites:** NURS 802, 804 and 807.
- NURS 841 ADVANCED GERONTOLOGICAL NURSING II**  
5 cr. (3 and 6)  
Continuation of NURS 840; builds on the review of research on the phenomenon of aging; continues the investigation of theories relevant to nursing care of the older adult; clinical experiences scheduled from a variety of settings that provide health care for older adults. **Prerequisite:** NURS 840.
- NURS 850 INFORMATION AND CONTROL SYSTEMS FOR NURSING LEADERSHIP**  
3 cr. (3 and 0)  
Computer-based systems of information management and control for nursing environments; data needed for cost-efficient use of nursing resources and effective systems of monitoring, quality assurance and control, emphasizing information systems as tools useful to humanistic nursing practice, human resource management, and solution of professional and scientific problems. **Prerequisite:** Graduate standing.



|                 |                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>NURS 861</b> | <b>ADVANCED ADULT NURSING I</b><br>5 cr. (3 and 6)<br>Theories and research related to physiological, psychological and sociocultural concepts that form the basis of advanced adult nursing practice; emphasis is on human responses to selected phenomena which influence the health status of adults; current issues and research influencing the practice of adult nursing. <b>Prerequisites or Corequisites:</b> NURS 802, 804 and 807. |
| <b>NURS 862</b> | <b>ADVANCED ADULT NURSING II</b><br>5 cr. (3 and 6)<br>Continuation of the study of theories, research and concepts that form the basis of adult nursing practice; emphasis is on factors influencing wellness and illness in the care of adults; related issues and current research. <b>Prerequisite:</b> NURS 861.                                                                                                                        |
| <b>NURS 879</b> | <b>SPECIAL TOPICS IN NURSING</b><br>1-3 cr. (1-3 and 0-9)<br>In-depth seminar on selected topics, such as therapeutic communication, legal and ethical issues in nursing, and health care and political process in health. <b>Prerequisite:</b> Permission of instructor.                                                                                                                                                                    |
| <b>NURS 881</b> | <b>GRADUATE PROJECT</b><br>Credit to be arranged.<br>Scholarly experience enhancing the student's professional goals with significance for nursing practice, education or administration; the project nature is flexible and is negotiated between the student and graduate committee. Minimum of three credit hours required for students selecting the nonthesis option. <b>Prerequisite:</b> Negotiated between student and committee.    |
| <b>NURS 889</b> | <b>SPECIAL PROBLEMS IN NURSING</b><br>1-6 cr. (1-6 and 0)<br>Problems selected to meet special and individualized interests of students. Up to six hours of NURS 889 may be taken as elective credit. <b>Prerequisites:</b> NURS 801, 804, 807 and permission of instructor.                                                                                                                                                                 |
| <b>NURS 891</b> | <b>MASTER'S THESIS RESEARCH</b><br>Credit to be arranged.<br>Research activities related to thesis; minimum of six hours required. <b>Prerequisites:</b> NURS 802, 804 and 807.                                                                                                                                                                                                                                                              |
| <b>HLTH 600</b> | <b>SELECTED TOPICS IN HEALTH</b><br>1-6 cr. (1-6 and 0)                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>HLTH 601</b> | <b>HEALTH CARE CONSUMERISM</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>HLTH 602</b> | <b>HEALTH CARE IN EMERGENCIES</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>HLTH 610</b> | <b>CONCEPTS OF CHILD HEALTH</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>HLTH 620</b> | <b>HEALTH PROMOTION AND WELLNESS INTERNSHIP</b><br>1-6 cr. (0 and 3-18)                                                                                                                                                                                                                                                                                                                                                                      |
| <b>HLTH 630</b> | <b>HEALTH PROMOTION OF THE AGED</b><br>3 cr. (3 and 0)                                                                                                                                                                                                                                                                                                                                                                                       |

|                 |                                                           |
|-----------------|-----------------------------------------------------------|
| <b>HLTH 631</b> | <b>PUBLIC AND ENVIRONMENTAL HEALTH</b><br>3 cr. (3 and 0) |
| <b>HLTH 650</b> | <b>APPLIED HEALTH STRATEGIES</b><br>3 cr. (3 and 0)       |
| <b>HLTH 698</b> | <b>CONTEMPORARY HEALTH PROBLEMS</b><br>3 cr. (3 and 0)    |

### Political Science

Timothy O'Rourke, Chair, Department of Political Science

| Major                 | Degree |
|-----------------------|--------|
| Public Administration | M.P.A. |

Advanced degrees are not awarded in political science. Courses are offered at the 600 level to provide electives for students in other areas.

The department participates with the Department of Government and International Relations at the University of South Carolina in offering the joint professional degree, Master of Public Administration. Courses for this program are taught only at the University Center of Greenville, S.C.

From 36 to 45 semester hours are required for the M.P.A. degree, depending on the student's background. Students who do not have substantial administrative experience are required to complete an internship encompassing at least three months of full-time administrative work. All M.P.A. students must complete six core courses, a core course that focuses on the level of government (e.g., local, state, etc.) in which the student is interested, and five electives.

|                  |                                                                         |
|------------------|-------------------------------------------------------------------------|
| <b>PO SC 604</b> | <b>GENDER AND POLITICS</b><br>3 cr. (3 and 0)                           |
| <b>PO SC 609</b> | <b>DIRECTED STUDY IN AMERICAN INSTITUTIONS</b><br>3 cr. (3 and 0)       |
| <b>PO SC 623</b> | <b>URBAN POLITICS</b><br>3 cr. (3 and 0)                                |
| <b>PO SC 626</b> | <b>TOTAL QUALITY MANAGEMENT IN THE PUBLIC SECTOR</b><br>3 cr. (3 and 0) |
| <b>PO SC 627</b> | <b>PUBLIC PERSONNEL MANAGEMENT</b><br>3 cr. (3 and 0)                   |
| <b>PO SC 628</b> | <b>NATIONAL SECURITY POLICY</b><br>3 cr. (3 and 0)                      |
| <b>PO SC 632</b> | <b>AMERICAN CONSTITUTIONAL LAW I</b><br>3 cr. (3 and 0)                 |
| <b>PO SC 633</b> | <b>AMERICAN CONSTITUTIONAL LAW II</b><br>3 cr. (3 and 0)                |
| <b>PO SC 642</b> | <b>POLITICAL PARTIES AND ELECTIONS</b><br>3 cr. (3 and 0)               |
| <b>PO SC 654</b> | <b>SOUTHERN POLITICS</b><br>3 cr. (3 and 0)                             |
| <b>PO SC 657</b> | <b>POLITICAL TERRORISM</b><br>3 cr. (3 and 0)                           |
| <b>PO SC 658</b> | <b>POLITICAL LEADERSHIP</b><br>3 cr. (3 and 0)                          |



- PO SC 662 INTERNATIONAL LAW AND ORGANIZATIONS**  
3 cr. (3 and 0)
- PO SC 821 PERSPECTIVES ON PUBLIC ADMINISTRATION**  
3 cr. (3 and 0)  
Study and practice of public administration in the United States in the twentieth century; examination of the historical development of the field of public administration and current approaches to the study and practice of public administration.
- PO SC 822 PUBLIC POLICY PROCESS**  
3 cr. (3 and 0)  
Major models of policy making, including incrementalism, rationalism, pluralism and elitism; selected areas of public policy, including transportation, poverty, energy and the environment.
- PO SC 827 PUBLIC PERSONNEL ADMINISTRATION**  
3 cr. (3 and 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.
- PO SC 829 PUBLIC FINANCIAL MANAGEMENT**  
3 cr. (3 and 0)  
Organization and techniques of governmental financial management; budgetary theories; intergovernmental financial relations.
- PO SC 834 ADMINISTRATIVE LAW**  
3 cr. (3 and 0)  
Study of the legislative, adjudicatory and general policy-making powers of administrative agencies and regulatory commissions, and the scope of judicial review of administrative action; directed primarily toward the analysis of the political nature of bureaucracy.
- PO SC 841 PUBLIC DATA ANALYSIS**  
3 cr. (3 and 0)  
Various aspects of locating, collecting and processing primary and secondary data utilized by public administrators and policy analysts, including design of original surveys, library and archive searches, problems of storage and retrieval, and statistical description. **Prerequisite:** EX ST 301, MTHSC 301 or equivalent.
- PO SC 860 AMERICAN GOVERNMENT**  
3 cr. (3 and 0)  
Introduction and overview of the literature of the American political system, its institutions and processes.
- PO SC 867 STATE GOVERNMENT ADMINISTRATION**  
3 cr. (3 and 0)  
State government problems and policy issues, emphasizing the modernization of government institutions and comparative state politics.
- PO SC 868 LOCAL GOVERNMENT ADMINISTRATION**  
3 cr. (3 and 0)  
Administration of local government from the perspective of the professional administrator, emphasizing the growth of the manager form of local government and the role of local government administrators with regard to policy making, management and the delivery of services.
- PO SC 877 PUBLIC POLICY EVALUATION SEMINAR**  
3 cr. (3 and 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 cr. (3 and 0)  
In-depth study of an applied problem in public administration as seen through the practitioner's eyes, and the methods used to address these problems.
- PO SC 879 INTERNSHIP IN PUBLIC ADMINISTRATION**  
1-3 cr. (1-3 and 0)  
Students serve an internship with a government agency; a written report must be submitted detailing the experience.
- These courses in Government and International Studies (GINT) are offered at the University Center of Greenville as part of the core courses in the joint program for the professional degree, Master of Public Administration.*
- GINT 767 STATE GOVERNMENT**  
3 cr. (3 and 0)  
State government problems and policy issues, emphasizing the modernization of government institutions and comparative state politics.
- GINT 771 PUBLIC DATA ANALYSIS**  
3 cr. (3 and 0)  
Problems of gathering and using public data for public administrators and policy analysis, including problems of research design and data gathering, interpretation and use in the analysis of public programs.
- GINT 773 PERSONNEL ADMINISTRATION**  
3 cr. (3 and 0)  
Organization, techniques and theories of personnel management; interpersonal relations in organizations; personnel change and development; changing conditions in the public service; educational specialization, unions, collective bargaining, etc.; ethics for public service.
- GINT 774 THE PUBLIC POLICY PROCESS**  
3 cr. (3 and 0)  
The public policy process, including the role of public officials in the process, and constraints on its outcomes.



## Psychology

Eugene H. Galluscio, Chair, Department of Psychology

| Majors                               | Degrees |
|--------------------------------------|---------|
| Applied Psychology                   | M.S.    |
| Industrial/Organizational Psychology | Ph.D.   |

Applicants to these programs in psychology 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.

A formal thesis and supervised field internship are required for the M.S. degree. M.S. students complete 45 semester hours, including six semester hours of thesis credit and six semester 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 semester hours of approved electives may be substituted for the field internship.

Students in the doctoral program are expected to satisfy the master's program requirements prior to receiving their doctorate. In addition to the required core content courses, a doctoral program must include at least one course from each of four major areas of psychology (biological, cognitive-affective, social, individual differences). In addition, 18 hours of dissertation research are required. Students are admitted to candidacy for the Ph.D. degree upon successful completion of a qualifying examination.

**PSYCH 615 SYSTEMS AND THEORIES OF PSYCHOLOGY**  
3 cr. (3 and 0)

**PSYCH 626 ADVANCED PHYSIOLOGICAL PSYCHOLOGY**  
3 cr. (3 and 0)

**PSYCH 635 HUMAN FACTORS PSYCHOLOGY**  
3 cr. (3 and 0)

**PSYCH 659 GROUP DYNAMICS**  
3 cr. (3 and 0)

**PSYCH 662 PSYCHOLOGY AND CULTURE**  
3 cr. (3 and 0)

**PSYCH 670 THEORIES OF PERSONALITY**  
3 cr. (3 and 0)

**PSYCH 680 HEALTH PSYCHOLOGY**  
3 cr. (3 and 0)

**PSYCH 683 ABNORMAL PSYCHOLOGY**  
3 cr. (3 and 0)

**PSYCH 699 SELECTED TOPICS**  
3 cr. (3 and 0)

**PSYCH 801 PROFESSIONAL ETHICS IN INDUSTRIAL/ ORGANIZATIONAL PSYCHOLOGY**  
2 cr. (2 and 0)  
Ethics and standards for the practice of psychology in organizations, emphasizing applied situations in organizational settings and in research. **Prerequisite:** Permission of instructor.

**PSYCH 810 RESEARCH DESIGN AND QUANTITATIVE METHODS I**  
3 cr. (3 and 0)  
Bivariate and multivariate data analysis applied to industrial and other work-related settings. Topics include the major data analytic tools

needed for research in applied psychology.

**Prerequisite:** Six credits of statistics, research methods or equivalent.

**PSYCH 811 RESEARCH DESIGN AND QUANTITATIVE METHODS II**  
3 cr. (3 and 0)

Research methodologies; experimental, quasi-experimental and nonexperimental designs, emphasizing applied psychological research. Special topics include scientific method, basic versus applied research, technical writing, grant writing and ethics. **Prerequisite:** PSYCH 810.

**PSYCH 815 ADVANCED STUDIES IN SYSTEMS AND THEORIES**  
3 cr. (3 and 0)

Advanced study of the foundations of contemporary psychology, the origins of major theories, the conceptions of scientific knowledge implicit in them, and the reasons for accepting or rejecting them. **Prerequisite:** PSYCH 415 or permission of instructor.

**PSYCH 822 HUMAN PERCEPTION AND PERFORMANCE**  
3 cr. (3 and 0)

Basic research on human perception as applied to task performance; focus is on vision and audition in adults, examining basic knowledge of human sensory and perceptual characteristics as applied to such tasks as machine operation, task performance, etc.

**PSYCH 833 COGNITIVE PSYCHOLOGY**  
3 cr. (3 and 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 845 ADVANCED STUDIES IN ADULTHOOD AND AGING**  
3 cr. (3 and 0)

Advanced study of human development from young adulthood through late adulthood; biological, cognitive, personality development and social development, examined from the perspective of several major theoretical frameworks. **Prerequisite:** PSYCH 345 or permission of instructor.

**PSYCH 852 ADVANCED STUDIES IN SOCIAL PSYCHOLOGY**  
3 cr. (3 and 0)

Human social behavior from the perspective of the individual as a participant in social relationships, emphasizing contemporary theories of human social behavior and human behavior in social settings. **Prerequisite:** PSYCH 352 or permission of instructor.

**PSYCH 860 PSYCHOLOGY OF TRAINING AND EVALUATION**  
3 cr. (3 and 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. **Prerequisite:** A course in industrial psychology, personnel psychology or equivalent.

- PSYCH 861 PERSONNEL PSYCHOLOGY**  
3 cr. (3 and 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. **Prerequisite:** PSYCH 810.
- PSYCH 862 ORGANIZATIONAL DEVELOPMENT**  
3 cr. (3 and 0)  
Forms of organizational structure and basic theories of organizations; theories and technologies of organizational development and change are stressed; course analyzes the relationships between organizational design and technology. **Prerequisite:** A course in industrial/organizational psychology or equivalent.
- PSYCH 863 WORK MOTIVATION AND SATISFACTION**  
3 cr. (3 and 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. **Prerequisite:** An industrial/organizational psychology course or equivalent.
- PSYCH 864 PERFORMANCE APPRAISAL**  
3 cr. (3 and 0)  
Job measurement and the psychological processes involved in performance appraisal, emphasizing current methods, theory and applications in the measurement of job performance; training in the development and evaluation of performance appraisal systems. **Prerequisite:** PSYCH 364 or permission of instructor.
- PSYCH 865 JOB ANALYSIS**  
3 cr. (3 and 0)  
Applied and theoretical issues in the analysis of work; structured techniques for person and job-oriented analyses; applications of job analysis in the areas of test development, performance appraisal and job evaluation. **Prerequisite:** PSYCH 364 or equivalent or permission of instructor.
- PSYCH 866 ATTITUDE MEASUREMENT THEORY**  
3 cr. (3 and 0)  
Classic and contemporary approaches to attitude theory, measurement and scaling techniques, emphasizing theories of job satisfaction and the measurement of attitudes toward work. **Prerequisite:** PSYCH 471 or permission of instructor.
- PSYCH 871 PSYCHOLOGICAL TESTS AND MEASUREMENT**  
3 cr. (3 and 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. **Prerequisite:** Permission of instructor.

- PSYCH 883 ADVANCED STUDIES IN ABNORMAL PSYCHOLOGY**  
3 cr. (3 and 0)  
Seminar on the etiology and classification of abnormal behavior, emphasizing empirical and theoretical issues in the understanding of mental disorders; cultural influences on judgment of abnormality and in-depth examination of specific psychological disorders. **Prerequisite:** PSYCH 483 or permission of instructor.
- PSYCH 891 MASTER'S THESIS RESEARCH**  
Credit to be arranged.
- PSYCH 895 APPLIED PSYCHOLOGY INTERNSHIP**  
3-6 cr. (0 and 3-6)  
Supervised field experience in industry, business or government; site location, on-site supervision and credit hours must be approved in advance by the graduate co-ordinator.
- PSYCH 897 SPECIAL PROBLEMS IN APPLIED PSYCHOLOGY**  
1-3 cr. (1-3 and 0)  
Study of a particular topic under the direction of a faculty member; specific program is organized by the student and faculty member and submitted to the graduate coordinator for approval; project is not used to support M.S. thesis. May be repeated for a maximum of six credits.
- PSYCH 898 INDUSTRIAL/ORGANIZATIONAL PSYCHOLOGY**  
3 cr. (3 and 0)  
Contemporary topics in industrial/organizational psychology. **Prerequisite:** Permission of instructor.
- PSYCH 899 SELECTED TOPICS**  
3 cr. (3 and 0)  
Selected current and classic topics not covered in other courses. May be repeated for credit.
- PSYCH 991 DOCTORAL DISSERTATION RESEARCH**  
Credit to be arranged.

## Public Health

Debra B. Jackson, Chair, Department of Public Health

| Major                 | Degree |
|-----------------------|--------|
| Health Administration | M.H.A. |

Clemson University and the Medical University of South Carolina jointly offer the Master of Health Administration degree. The M.H.A. program consists of 50 semester hours of course work: 21 hours of health administration, 21 hours of business and eight hours of graduate electives. Depending on a student's background, a three-credit internship may be required. All classes are taught at the University Center of Greenville by faculty from the Medical University of South Carolina and Clemson University.



*These courses are the core courses in the program. The MBA and MGT course descriptions are under the respective departmental headings.*

- MHA 719 HEALTH CARE MANAGEMENT**  
3 cr.  
Internal management of health facilities operations, emphasizing the modern hospital; governance, medical staff relations, JCAHO standards, quality assurance, and management of various departments and functional units.
- MHA 721 HEALTH CARE AND DELIVERY SYSTEMS**  
3 cr.  
Health services delivery systems in the United States including the historic development and current institutional structures, policy issues, public health concepts, health care access, health-seeking behavior, current proposals for national reform and the challenges facing health care administrators in various sectors.
- MHA 722 HEALTH BEHAVIOR AND EPIDEMIOLOGY**  
3 cr.  
Assessment and understanding of the health behavior and health status of a population and of individuals through the perspective of epidemiology, social and physiological aspects of health and illness, the conceptual tools to translate epidemiological findings and the relevance of bioethical issues for the health administrator.
- MHA 729 HEALTH CARE FINANCE**  
3 cr.  
Selected financial management and corporate financial topics including working capital management, capital budgeting, debt and equity instruments, financial statement analysis, and stock and bond valuations.
- MHA 734 HEALTH ECONOMICS AND POLICY**  
3 cr.  
Economic and policy concepts, analysis of those concepts as applied to health systems in the United States; the perspective of supply, cost and demand determination; economic and political decision making and the delivery of health services; the rapid changes now taking place in the U.S. health care industry; and opportunities to explore selected policy issues through the application of economic and political concepts and behavioral models.
- MHA 735 HEALTH LAW AND RISK MANAGEMENT**  
2 cr.  
Legal concepts and issues related to health care management, statutory law and state decisions, hospitals as corporate entities, the hospital board and policy setting, regulation of the health care industry, credentialing, quality assurance, risk management, understanding patient rights, privacy rights, financial obligations and the challenging decisions facing health care administrators at present.
- MHA 752 HEALTH ADMINISTRATION FIELD PROJECT**  
3 cr.  
Field experience options to students enrolled in the Master of Health Administration (MHA)

program in cooperation with the MUSC Medical Center and other excellent local and state health care providers; the length and scope of these options vary, depending on previous health care experience of the students as well as their needs/interests in a specialty area or organization; in combination with the formal professional instruction of the MHA program, quality field experiences provide an essential applied perspective to a challenging career.

- MHA 853 SEMINAR IN HEALTH ADMINISTRATION**  
2 cr.  
Overview of the Master of Health Administration curriculum as a whole; integration and evaluation, within the context of strategic management, of skills obtained and the critical thinking abilities developed throughout the course of the program; the latest research and literature on strategic health care management
- M B A 803 STATISTICAL ANALYSIS OF BUSINESS OPERATIONS**  
3 cr. (3 and 0)
- M B A 804 MANAGERIAL ACCOUNTING AND INFORMATION SYSTEMS**  
3 cr. (3 and 0)
- M B A 806 OPERATIONS MANAGEMENT**  
3 cr. (3 and 0)
- M B A 808 MANAGERIAL PROBLEMS IN MARKETING**  
3 cr. (3 and 0)
- M B A 810 MANAGERIAL POLICY**  
3 cr. (3 and 0)
- MGT 809 (M B A 809) ORGANIZATION THEORY AND BEHAVIOR**  
3 cr. (3 and 0) F
- MGT 815 PERSONNEL MANAGEMENT**  
3 cr. (3 and 0)



## DIRECTORY FOR CORRESPONDENCE

### Mailing Address

Clemson University, Clemson, SC 29634

### University Switchboard

(803) 656-3311

### Affirmative Action

Office of Human Resources, E-103 Martin Hall,  
telephone (803) 656-3181, zip: 29634-5004

### Assistantships

Address the chair of the department of proposed major.

### Financial Aid

Office of Student Financial Aid, G01 Sikes Hall,  
telephone (803) 656-2280, zip: 29634-5123

### Graduate Study

Graduate School Office, E-106 Martin Hall,  
telephone (803) 656-3195, zip: 29634-5120

### Housing

Housing Office, 200 Mell Hall, telephone (803) 656-2295, zip: 29634-4075

### International Programs and Services

Office of International Programs and Services,  
E-208 Martin Hall, telephone (803) 656-2457,  
zip: 29634-5120

### Public School Teachers Information

Agricultural Education, telephone (803) 656-3300,  
zip: 29634-0356  
Curriculum and Instruction (Elementary and Secondary  
Education), telephone (803) 656-5108, zip: 29634-0709  
Technology and Resource Development (Industrial  
Education), telephone (803) 656-3645,  
zip: 29634-0711  
Off-Campus Courses—Office of Extension and Public  
Relations, telephone (803) 656-2498, zip: 29634-0713

Clemson University



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### Registration and Class Schedules

Registrar, 102 Sikes Hall, telephone (803) 656-2171,  
zip: 29634-4019

### Telecampus

Director, E-205 Martin Hall, telephone (803) 656-4227  
or 1-800-922-8316 (within South Carolina), or 1-800-332-6406 (outside South Carolina), zip: 29634-5121

### Transcripts

Registrar, 104 Sikes Hall, telephone (803) 656-2173,  
zip: 29634-4019

### Vice President for Research

Vice President for Research, 300 Brackett Hall,  
telephone (803) 656-4538, zip: 29634-5701

### Veterans Affairs

Registrar, 102 Sikes Hall, telephone (803) 656-5280,  
zip: 29634-4019

The business and administrative offices of the University are open 8 a.m. to 4:30 p.m. Monday through Friday for 12 months of the year except for official University holidays.





CLEMSON UNIVERSITY  
Clemson, South Carolina 29634