Admission
Applicants for admission to the MS and PhD programs in materials science and engineering and polymer engineering are expected to have completed a bachelor’s degree in an area of engineering or science with a grade-point-average of at least 3.00 out of 4.00 both overall and in the senior year. In addition, all applicants must submit scores from the general Graduate Record Examination (GRE). Applicants whose native language is not English must score at least 213 on the computer-based TOEFL examination, 550 on the written examination, or 80 on the Internet-based Test to be considered for admission to the programs.

MASTER OF SCIENCE
MATERIALS SCIENCE AND ENGINEERING MAJOR

POLYMER ENGINEERING MAJOR

Thesis Option
A total of 30 hours is required for the MS with a major in either materials science and engineering or polymer engineering. Additional requirements include the following.

- A major consisting of 12 hours of graduate courses in materials science and engineering or polymer engineering. The materials science and engineering major must include 511, 512, 515, and 516 for the metallurgy concentration; 511, 512, 540, and 541 for the polymers concentration; 511, 512, and two graduate specialization courses approved by the student's faculty committee for the materials concentration; and 511, 512 and two courses from the approved nanomaterials specialization list for the nanomaterials concentration.

- Additional courses up to 12 hours total in related areas.

- Master's thesis 500, totaling 6 to 12 hours.

- Satisfactory performance on a comprehensive oral examination administered by the faculty committee.

All resident students are required to participate in the graduate seminar in materials science and engineering or polymer engineering, as appropriate, during each semester in which it is offered. Three hours of Materials Science and Engineering 503 or 504 may be counted toward degree requirements.

Non-Thesis Option
Any candidate may apply for a non-thesis option. Upon acceptance, a supervisory committee of three will be appointed. At least two members of the committee will be from the faculty in the major area, either materials science and engineering or polymer engineering. The requirements for completion of the non-thesis option are as follows.

- Completion of a total of 30 hours of graduate coursework. At least 18 of those hours must be in the department and up to 12 hours may be in related areas. Three hours of Materials Science and Engineering 503 or 504 may be counted toward degree requirements. The materials science and engineering major and the polymer engineering major must include the same courses required for the thesis option. The faculty committee must approve the candidate's degree program.

- Satisfactory completion of Materials Science and Engineering 580 (Critical Review) as a culminating experience. This course shall include a comprehensive examination administered by the faculty committee.

DUAL MS-MBA

Materials Science and Engineering Major

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Name</th>
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<th>Credit</th>
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<tr>
<td>Fall – First Year</td>
<td>Business Administration 501 (MBA Career Development)</td>
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<tr>
<td>Spring</td>
<td>Business Administration 513 (MBA Core III)</td>
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<tr>
<td>Summer</td>
<td>Engineering Major</td>
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<tr>
<td>Fall – Second Year</td>
<td>Engineering Major 1</td>
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<td>Spring</td>
<td>MBA Innovative &amp; Entrepreneurship Elective</td>
<td>6</td>
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</tr>
</tbody>
</table>

Total 61

1 Engineering Major courses must be selected to satisfy Materials Science and Engineering major degree requirements.

DOCTOR OF PHILOSOPHY
MATERIALS SCIENCE AND ENGINEERING MAJOR

POLYMER ENGINEERING MAJOR

After one year in residence and with the approval of the faculty, a student may proceed directly to the doctoral program without completion of a master's degree.

Requirements
Departmental requirements for completion of the doctoral degree are as follows.

- Satisfactory performance on the applicable comprehensive examination.
- Active participation in graduate seminars conducted by the department.
- For students proceeding directly to the PhD from the baccalaureate degree, a minimum of 72 graduate hours is required. These hours must include 42 graduate course hours with at least 6 hours of 600-level courses and 30 hours of dissertation. Six hours of Materials Science and Engineering 503 or 504 may be counted toward degree requirements. At least 24 hours must be courses taught in the department. The materials science and engineering major and the polymer engineering major must include the courses required for the master’s program. For students in the nanomaterials concentration at least 12 hours of coursework must be from the approved nanomaterials specialization list.
- For students having a thesis-based master's degree from UT in materials science and engineering or polymer engineering or a master's degree from another university in materials science and engineering, polymer engineering, or metallurgical engineering, a minimum of 48 graduate hours is required. These hours must include 18 hours of graduate coursework with at least 6 hours of 600-level courses and 30 hours of dissertation. Three hours of Materials Science and Engineering 503 or 504 may be counted toward degree requirements. For students in the nanomaterials concentration at least 12 hours of coursework must be from the approved nanomaterials specialization list. At least 12 hours must be courses in the department.
- For students having a non-thesis master’s degree from UT in materials science and engineering or polymer engineering, a minimum of 48 graduate hours is required. These must include 15 hours of graduate coursework with at least 6 hours of 600-level courses and 33 hours of dissertation. For students in the nanomaterials concentration at least 12 hours of coursework must be from the approved nanomaterials specialization list. Three hours of Materials Science and Engineering 503 or 504 may be counted toward degree requirements. At least 12 hours must be courses in the department.

### DEPARTMENT OF MECHANICAL, AEROSPACE, AND BIOMEDICAL ENGINEERING

http://www.engr.utk.edu/mabe/

**Professors**

- Antar, B.N. (UTSI), PhD . Texas
- Arimilli, R.V., PhD . Virginia Tech
- Baker, A.J., PhD, PE . New York
- Dareing, D.W., PhD, PE . Illinois
- Flandro, G.A. (UTSI), PhD . California Institute of Technology
- Frankel, J.I., PhD . Virginia Tech
- Hamel, W.R., PhD . Tennessee
- Keyhani, M., PhD . Ohio State
- Khim, K.D., PhD . Stanford
- Komistek, R.D., PhD . Memphis
- Landes, J.D., PhD, PE . Lehigh
- Majdalani, J.C. (UTSI), PhD . Utah
- Parang, M. (Associate Dean), PhD, PE . Oklahoma
- Parsons, J.R., PhD, PE . North Carolina State
- Schulz, R.J. (UTSI), PhD . Tennessee
- Smith, G.V., PhD, PE . Penn State
- Soliman, O., PhD, PE . Tennessee
- Steinhoff, J.S. (UTSI), PhD . Chicago
- Vakili, A. (UTSI), PhD . Tennessee

**Associate Professors**

- Boulet, J.A.M., PhD . Stanford
- Chellaboina, V.S., PhD . Georgia Tech
- Lin, C.X., PhD . Chongqing (People’s Republic of China)
- Lyne, J.E., MD, PhD . North Carolina State
- Madhukar, M.S., PhD . Drexel
- Moulden, T.H. (UTSI), PhD . Tennessee
- Nguyen, K., PhD . Colorado
- Pionke, C.D., PhD, PE . Georgia Tech

**Assistant Professors**

- DeSmidt, H.A., PhD . Penn State
- He, W., PhD . Connecticut
- Lee, D., PhD . Minnesota
- Mahfouz, M.R., PhD . Colorado School of Mines
- Zhang, M., PhD . Washington (St. Louis)
- Zhao, X., PhD . Virginia Tech

**Emeriti Faculty**

- Carley, T.G., PhD, PE . Illinois
- Forrester, J.H., PhD, PE . Iowa State
- Hodgson, J., PhD, PE . Georgia Tech
- Johnson, W.S., PhD, PE . Clemson
- Mathews, A., PhD, PE . Illinois
- Milligan, M.W., PhD, PE . Tennessee
- Shannon, T.E., PhD, PE . Tennessee
- Snyder, W.T., PhD . Northwestern
- Wasserman, J.F., PhD, PE . Cincinnati

**Graduate Certificate Program**

- Computational fluid mechanics

**MAJORS**

### DEGREES

**Aerospace Engineering**

- MS, PhD
  - Aeronautics concentration
  - Aerodynamics and performance concentration
  - Energy conversion and utilization concentration
  - Flight and aerospace mechanics concentration
  - Gas dynamics concentration
  - Heat transfer and fluid mechanics concentration
  - Propulsion concentration
  - Space engineering concentration (UTSI only)
  - Structures and stress analysis concentration
  - Thermodynamics concentration

**Biomedical Engineering**

- MS, PhD
  - Biofluid mechanics concentration
  - Bioimaging concentration
  - Biomaterials concentration
  - Cell and tissue engineering concentration
  - Musculoskeletal biomechanics concentration

**Biomedical Engineering**

- MS-MBA

**Engineering Science**

- MS
  - Applied artificial intelligence concentration
  - Biomedical engineering concentration
  - Computational mechanics concentration
  - Fluid mechanics concentration
  - Mechanics of composite materials concentration
  - Optical engineering concentration (UTSI only)
  - Product development and manufacturing concentration
  - Solid Mechanics concentration

**Engineering Science**

- PhD
  - Applied artificial intelligence concentration
  - Biomedical engineering concentration
  - Computational mechanics concentration
  - Fluid mechanics concentration
  - Industrial engineering concentration
  - Mechanics of composite materials concentration
  - Optical engineering concentration (UTSI only)
  - Solid mechanics concentration

**Mechanical Engineering**

- MS
  - Aerodynamics and performance concentration
  - Energy conversion and utilization concentration
  - Gas dynamics concentration
  - Heat transfer and fluid mechanics concentration
  - Machine design concentration
  - Power generation concentration
  - Product development and manufacturing concentration
  - Propulsion concentration
  - Space engineering concentration (UTSI only)
  - Stress analysis concentration
  - Thermodynamics concentration

**Mechanical Engineering**

- MS-MBA

**Mechanical Engineering**

- PhD
  - Dynamics, control, and robotics concentration
  - Energy conversion and utilization concentration
  - Gas dynamics concentration
  - Heat transfer and fluid mechanics concentration
  - Machine design concentration
  - Power generation concentration
  - Propulsion concentration
  - Space engineering concentration (UTSI only)
  - Stress analysis concentration
  - Thermodynamics concentration

**Reliability and Maintainability Engineering**

- MS
  - Aerospace engineering concentration
  - Biomedical engineering concentration
  - Mechanical engineering concentration

**Graduate Certificate Program**

- Computational fluid mechanics

* Engineering science degree may also be used for interdisciplinary fields in all graduate engineering programs.
Graduate programs leading to the Master of Science and Doctor of Philosophy are available with majors in mechanical engineering, aerospace engineering, biomedical engineering, and engineering science. Changing from one of these programs to another requires departmental approval. Each applicant is advised to any prerequisite courses before entering a program.

Within the engineering science concentrations interdisciplinary programs are arranged to meet individual needs or interests. The flexibility and interdisciplinary aspect of the program concentrations are intended to be of particular interest to prospective students currently employed in research, development, or design activities and whose interests in continuing education (either full-time or part-time) lie at one of the interfaces between science and engineering or can best be met by interdisciplinary study in engineering. The program's course offerings and research activities are also intended to meet the needs of students who seek preparation for employment in engineering areas requiring specialization in mechanics or in related interdisciplinary studies such as bio-mechanics.

In mechanical engineering or aerospace engineering, entrance into the Master of Science program is available to qualified graduates of recognized undergraduate curricula in mechanical or aerospace engineering and to qualified graduates of other curricula who satisfy the necessary prerequisites. A program application is required in addition to the Graduate Application for Admission. Admission into the doctoral program will be granted to those applicants who have demonstrated superior achievement in their engineering backgrounds. The general GRE is required of all applicants for admission.

In biomedical engineering, entrance into the graduate program is available to graduates of recognized curricula in engineering, mathematics, or one of the physical sciences who satisfy the necessary prerequisites. A program application is required in addition to the Graduate Application for Admission. The names and addresses of three references must be included with the program application. The general GRE is required of all applicants for admission.

In engineering science, entrance into the graduate program is available to graduates of recognized curricula in engineering, mathematics, or one of the physical or biological sciences. A program application is required in addition to the Graduate Application for Admission. The names and addresses of four references must be included with the program application. The general GRE is required of all applicants for admission.

Each student must satisfactorily complete a program of study that has been approved by his/her advisory committee and complies with the requirements of the Graduates of Mechanical, Aerospace, and Biomedical Engineering; however, at least one member of the student's graduate advisory committee must be on the faculty of the Department of Mechanical, Aerospace, and Biomedical Engineering.

FIVE-YEAR BS-MS PROGRAM

The department offers a 5 year BS-MS program for qualified students. The primary component of the program is that qualified students may take up to 9 hours of approved graduate courses for their senior undergraduate electives and have them count toward both their bachelor's and master's degrees.

Significant components of the program are:

Students must have an overall GPA of at least 3.4 to be admitted to the program. Conditional admission may be granted after completing 64 hours of required coursework while full admission is granted after completing 96 hours of required coursework with a minimum overall GPA of 3.4 in required coursework. Students must have at least one 400-level engineering course to meet their advanced degree requirements. Undergraduate courses that are required for their senior undergraduate electives and have them count toward both their bachelor's and master's degrees. All courses taken for graduate credit must be approved by the Chair of the program and the Graduate School.

Admission of students into this program must be approved by the department, the College of Engineering, and the Graduate School.

Students will not be eligible for assistantships until they complete their bachelor's degree.

This program may also be used by students entering our doctoral programs directly after receiving their bachelor's degree.

Graduate Credit for Undergraduate Courses

Students majoring in mechanical engineering, aerospace engineering or biomedical engineering may not normally use more than one 400-level engineering course to meet their advanced degree requirements. Undergraduate courses that are required for the bachelor's degree in mechanical engineering may not be taken for graduate credit by graduate students in biomedical engineering. Undergraduate courses that are required for the bachelor's degree in aerospace engineering may not be taken for graduate credit by graduate students in aerospace engineering.

Undergraduate courses that are required for the bachelor's degree in biomedical engineering may not be taken for graduate credit by graduate students in biomedical engineering. Students majoring in engineering science, 400-level graduate courses in engineering may be used to meet requirements at the discretion of the advising committee. However, at least two-thirds of the minimum required hours in a master's degree program must be at or above the 500-level. With the approval of the student's major department, a student whose major is outside the Department of Mechanical, Aerospace, and Biomedical Engineering may take 400-level graduate courses in the department. Such students should consult with instructors regarding prerequisites for undergraduate courses.

MASTER OF SCIENCE

AEROSPACE ENGINEERING MAJOR

BIOMEDICAL ENGINEERING MAJOR

ENGINEERING SCIENCE MAJOR

MECHANICAL ENGINEERING MAJOR

Requirements

In aerospace engineering, mechanical engineering, biomedical engineering, and engineering science, two MS options are offered. Option I requires a thesis. Option II does not require a thesis and provides graduate students, including co-op and other off-campus students, the opportunity to focus their programs in special areas through extended coursework.

Aerospace Engineering Major • Biomedical Engineering Major • Mechanical Engineering Major • Option I (Thesis)

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</table>

Courses in program (500-level or above) – 12 hours minimum. Mathematics (400-level or above) – 6 hours minimum.

Aerospace Engineering Major • Biomedical Engineering Major • Mechanical Engineering Major • Option II (Non-Thesis)

<table>
<thead>
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<th>Hours</th>
<th>Credit</th>
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<tr>
<td>Total</td>
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</tbody>
</table>

Courses in program (500-level or above) – 18 hours minimum. Mathematics (400-level or above) – 6 hours minimum. 590 Selected Engineering Problems – 6 hours maximum.
Program Committee Chair, including a concentration. This program requires a coursework plan, approved by the Dual
required to take 18 hours of graduate-level engineering courses.

1 MS requirements: 12 hours minimum in major and 6 hours minimum

1Engineering courses – 12 hours minimum (major concentration may
include, but is not restricted to, courses offered by the department).
Mathematics (400-level or above) – 6 hours minimum. Related courses– 9 hours maximum (may include additional courses in mathemat-
ics, computer science, or the physical and life sciences).

The College of Engineering offers a graduate certificate in
computational fluid dynamics (CFD). The program is designed
primarily for the part-time student interested in gaining dexterity
in this subject by taking a course sequence through distance ed-
ucation. All coursework is permanently archived at the College of
Engineering Computational Fluid Dynamics Laboratory Web site,

Additional requirements for all students include the following.
• A minimum of 24 semester hours in engineering science, the courses must include the following.
  • A minimum of 12 semester hours of graduate credit in
    mathematics courses numbered 400 or above with a min-
    imum of 6 hours numbered 500 or above.
  • A minimum of 24 semester hours in the department in
courses numbered 500 and above, with at least 12 of
these hours in the major. A minimum of 9 semester hours of
courses is required at the 600 level. These are exclu-
sive of thesis, problems, or dissertation credit. The stu-
dent’s advisory committee can approve a student’s peti-
tion to replace one 600-level course with one or more 500-
level course(s) that are more appropriate.

In engineering science, the courses must include the following.
• A minimum of 24 semester hours in engineering graduate
courses, exclusive of thesis and dissertation credit. These
courses will normally be numbered 500 and above, with at
least 9 semester hours of 600-level courses, which consti-
tute one or two areas of concentration selected by the stu-
dent. The number of courses in this group to be taken will
depend on the program selected by the student and the
approval of his/her advisory committee.
• A minimum of 12 semester hours in mathematics or com-
puter science in courses numbered 400 and above, exclu-
sive of a first course in ordinary differential equations.

In aerospace engineering, aerospace engineering, or bio-
medicalengineering, the courses must include the following.
• A minimum of 12 semester hours of graduate credit in
mathematics courses numbered 400 or above with a min-
imum of 6 hours numbered 500 or above.
• A minimum of 24 semester hours in the department in
courses numbered 500 and above, with at least 12 of
these hours in the major. A minimum of 9 semester hours of
courses is required at the 600 level. These are exclu-
sive of thesis, problems, or dissertation credit. The stu-
dent’s advisory committee can approve a student’s peti-
tion to replace one 600-level course with one or more 500-
level course(s) that are more appropriate.

In mechanical engineering, aerospace engineering, or bio-
medicalengineering, the courses must include the following.
• A minimum of 24 semester hours in engineering graduate
courses, exclusive of thesis and dissertation credit. These
courses will normally be numbered 500 and above, with at
least 9 semester hours of 600-level courses, which consti-
tute one or two areas of concentration selected by the stu-
dent. The number of courses in this group to be taken will
depend on the program selected by the student and the
approval of his/her advisory committee.
The sole academic prerequisite for the certificate program is a bachelor’s degree in engineering. Applicants must meet the minimum admission requirements of the University of Tennessee, Knoxville, Graduate and International Admissions Office and become admitted thereto.

**DEPARTMENT OF NUCLEAR ENGINEERING**

http://www.engr.utk.edu/nuclear/

H. L. Dodds, Head and Graduate Program Director

**Professors**

Dodds, H.L. (IBM Professor), PhD, PE  - Tennessee

Fontana, M.H. (Research), PhD, PE  - Purdue

Ganapoli, B.D. (Research), PhD  - California (Berkeley)

Grossbeck, M.L. (Research), PhD  - Illinois

Hines, J.W., MBA, PhD  - Ohio State

Mihalcev, J.T. (Research), PhD  - Tennessee

Miller, L.F., PhD, PE  - Texas A&M

Mynatt, F.R. (Research), PhD  - Tennessee

Pettengill, H.J. (Research), PhD  - Michigan

Ruggles, A.E., PhD  - Rensselear Polytechnic

Townsend, L.W., PhD  - Idaho

Upadhyaya, B.R., PhD, PE  - California (San Diego)

**Associate Professors**

Cook, D.H., PhD  - Tennessee

Maldonado, G., PhD  - North Carolina State

Pevey, R.E., MBA (Emory), PhD, PE  - Tennessee

**Assistant Professors**

Gribok, A.V. (Research), PhD  - IPPE (Russia)

Hayward, J.F., PhD  - Michigan

Moussa, H.M. (Research), PhD  - Tennessee

Stephan, A.C. (Research), PhD  - Tennessee

**Adjunct Faculty**

DeHart, M.D., PhD  - Texas A&M

Gehin, J.C., PhD  - Massachusetts Institute of Technology

Icenhour, A.S., PhD  - Tennessee

Nichols, T.L., MD  - Tennessee

Ramsey, W.R., PhD  - Tennessee

**Emeriti Faculty**

Groer, P.G., PhD  - Vienna (Austria)

Uhrig, R.E. (Distinguished Professor), PhD, PE  - Iowa State

**MAJOR DEGREES**

**Nuclear Engineering**

Radiological engineering concentration

**Nuclear Engineering**

MS-MBA

**Reliability and Maintainability Engineering**

Nuclear engineering concentration

**Graduate Certificate Programs**

Nuclear criticality safety

The Department of Nuclear Engineering offers programs leading to the Master of Science and Doctor of Philosophy degrees. Students may elect a traditional nuclear engineering program focusing on fission energy or a radiological engineering concentration, which prepare students for careers in the radiation safety field (health physics). Both programs are designed for graduates of accredited undergraduate programs in engineering, physics, chemistry, or mathematics.

All entering students must have, as a minimum, competency in mathematics through ordinary differential equations, competency in atomic and nuclear physics, and competency consistent with an introductory course in nuclear engineering. If such competencies do not exist, the student must take appropriate courses for undergraduate credit. In addition, students without a BS in nuclear engineering, or the equivalent, must take 431 (Radiation Protection) and 470 (Nuclear Reactor Theory I), both of which may be taken for graduate credit. The department head is the contact for all interested students, both those with nuclear engineering degrees and those from other disciplines.

**Graduate Credit for Undergraduate Courses**

400-level courses in nuclear engineering may be used for graduate credit. However, at least two-thirds of the minimum required hours in the MS must be taken in courses numbered 500 or above.

**MASTER OF SCIENCE NUCLEAR ENGINEERING MAJOR**

A graduate program leading to the Master of Science degree is available to graduates of recognized undergraduate curricula as described above. Each applicant will be advised as to the necessary prerequisite courses before he/she enters the program.

**Requirements**

The minimum requirements for the MS in nuclear engineering are:

- A major consisting of 12 hours of graduate courses in nuclear engineering which must include at least two of the following courses – 511, 521, 552, 571.
- A minor consisting of 6 hours of elective courses in mathematics, statistics, or another field related to nuclear engineering.
- 6 hours in either nuclear engineering or a related field.
- One of the following four options for a culminating experience:
  - Option 1 – a thesis project (6 hours of 500).
  - Option 2 – two to four engineering practice projects (6 hours of 598).
  - Option 3 – one engineering practice project (3 hours of 598) plus 3 hours of additional nuclear engineering coursework.
  - Option 4 – six hours of additional nuclear engineering coursework and a comprehensive written exam on all coursework prepared by the student’s graduate committee (i.e., no thesis or engineering practice project).

The determination on which option a student may undertake is made by the student’s graduate committee and is based on the student's personal interests, academic background, and work experience, as well as the nature of projects currently available in the department. A thesis project requires the student to conduct independent, in-depth research. An engineering practice project is similar to a thesis project but smaller in scope and can be research, design, product development, special operations, or a critical review of published literature in a specific technical area. The student must submit a brief written proposal for each project undertaken, either thesis or engineering practice, which must be approved by the student’s graduate committee. The final report for an engineering practice project is normally prepared in thesis format (i.e., according to the Graduate School, Guide to the Preparation of Theses and Dissertations); however, another formal report format may be used if approved by the student’s graduate committee. The student must also register for the appropriate number of hours of either 500 or 598, as specified by the student’s major professor, during each semester that work is performed on a thesis or engineering practice project. Finally, the student must pass an oral examination on all work presented for the degree (all coursework and all projects).

The MS with a major in nuclear engineering is also available to distance students via selected courses that are delivered synchronously over the Web to the student’s computer. More detailed information about this distance program is located at http://www.anywhere.tennessee.edu/ne/default.htm.
DUAL MS-MBA

**Nuclear Engineering Major**

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</tr>
</tbody>
</table>

**Total 61**

1 Engineering Major courses must be selected to satisfy Nuclear Engineering major degree requirements.

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**DOCTOR OF PHILOSOPHY**

**NUCLEAR ENGINEERING MAJOR**

Students in the field of nuclear engineering desiring to study for the Doctor of Philosophy degree must have a Bachelor of Science or Master of Science from a recognized university with a major in engineering, physics, chemistry, or mathematics. All candidates will be required to demonstrate general competence in a comprehensive examination in the areas of engineering science, mathematics, chemistry, physics, and nuclear engineering.

**Requirements**

Specific requirements for the PhD with a major in nuclear engineering include the following:

- A minimum of 48 hours beyond the bachelor’s degree, exclusive of credit for the MS thesis or nuclear engineering practice.
- A minimum of 24 hours in doctoral research, Nuclear Engineering 600.
- A minimum of 30 hours in nuclear engineering courses numbered 500 and above (or the equivalent), with at least 6 hours of 600-level courses. These are exclusive of thesis or dissertation credit. Three of the 6 hours of 600-level courses can be from a department other than nuclear engineering, provided the selection supports the student’s research area.
- A minimum of 12 hours in mathematics, statistics or other courses related to nuclear engineering beyond nuclear engineering undergraduate requirements numbered 400 or above.
- A minimum of 6 hours in courses numbered 500 or above from a department other than nuclear engineering. The choice depends on the student’s overall program and should expand his/her knowledge in a given field.

The first part of the comprehensive examination is prepared by the nuclear engineering faculty and consists of 6 hours of written examination that is administered over a two-day period. All past written examinations are filed in the library and students are encouraged to review them. Students are invited to take the written examination after completing approximately 30 hours of graduate coursework. A student who fails the written examination must take and pass the examination the next time it is offered to remain in the PhD program. Registration for 600 is not permitted until the written examination is passed. The second part of the comprehensive examination is completed with the successful oral defense of a written dissertation proposal.

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A candidate must successfully defend, in an oral examination, all work presented for the degree (all coursework and the dissertation).

**GRADUATE CERTIFICATE IN NUCLEAR CRITICALITY SAFETY**

The Department of Nuclear Engineering offers a graduate certificate in nuclear criticality safety. The program is designed primarily for part-time students. All of the courses are available through distance education (see http://www.anywhere.tennessee.edu/ne/default.htm).

The 12-hour certificate is earned by completing 421, 543, and 582 plus one of the following two courses: 470 or 571. The selection of one of the latter two courses is determined through an advising conference with each individual student and is based on the student’s personal interests, academic background, and work experience. Applicants must meet the minimum criteria established by the Graduate Council. Students without a nuclear engineering background must take Nuclear Engineering 301 prior to beginning the graduate coursework described above.
The University of Tennessee College of Law commenced operation in 1890 and has continuously sought to provide high-quality legal education in a university community.

The principal objective of the college is to prepare students for the practice of law. The college teaches the analytical skills needed to interpret cases and statutes, the ability to communicate effectively, an awareness of the historical growth of the law, a knowledgeable appreciation of the interrelationship of law and society, and the ability to use law as an implement of social change and development. Students are thus equipped to serve their communities not only as advocates and counselors, but as policy makers and active, responsible citizens.

The program of the college has three dimensions – teaching and learning, research into and appraisal of our legal systems and institutions, and service to the community. Each plays a significant role in the college as a modern law center.

The teaching and learning element of legal education at the college involves a co-operative classroom interaction between faculty and students in the analytical study of a host of questions and problems found in today's legal profession. These involve decisional law, statutory interpretation, administrative regulation, techniques of trial and appellate advocacy, and the roles and responsibilities of the lawyer in advising and representing clients.

The college is also directly involved in providing service to the community. A major element of public service is centered in the Legal Clinic where students, under the guidance of skilled and experienced licensed practitioners, provide legal services to clients. Additionally, through research, consultation, and other services to legal institutions and groups within the state, the college seeks to participate in the development and improvement of the society in which its students may eventually practice law.

In combination, the direction and objectives of the college lead to the development not of a narrow technician, but of a student of the law with the perspective, breadth, and understanding necessary to accomplish the many tasks assigned by society to the legal profession.
Graduate Programs
The College of Law offers the Doctor of Jurisprudence degree program; a dual degree program with the College of Business Administration leading to the JD and the Master of Business Administration degree; and a dual degree program with the Department of Political Science, College of Arts and Sciences, leading to the JD and Master of Public Administration. In addition graduate students may be eligible to take a limited number of law courses to count toward a graduate degree.

Current information regarding admission, financial aid, course requirements, academic policies, extracurricular activities, and student services is available from the Admissions Office, The University of Tennessee College of Law, 1505 West Cumberland Avenue, Knoxville, Tennessee 37996-1810 and at the college’s Web page www.law.utk.edu. Completed application should be received before February 1 of the year of requested admission.

DOCTOR OF JURISPRUDENCE
The Doctor of Jurisprudence degree will be conferred upon candidates who complete, with the required average, six semesters of resident law study and who have 89 hours of credit, including all required courses. Of the required 89 hours of credit, no more than 18 hours of credit may be earned in any combination of the following courses – 947, 993, 994, 995, 996, or 997. The required average is 2.0 and that average must be maintained on the work of all six semesters and also for the combined work of the grading periods in which the last 28 hours taken in residence were earned. Averages are computed on weighted grades and rounded to one decimal point. Grades are awarded on a numerical scale (in increments of 0.1) from 0.0 to 4.3. No credit toward the JD degree is awarded for grades of 0.0 to 0.7. Law student grade point averages are reported on the official transcript rounded to one decimal place. Law school grade point averages are also rounded to one decimal place for determining academic honors and class rank.

Eligible law students may receive up to 6 hours of credit toward the JD for acceptable performance (a grade of B or higher) in upper-level courses that materially contribute to the study of law and which are taken in other departments at the University of Tennessee, Knoxville. Course selection and registration are subject to guidelines approved by the faculty. The approval of courses is the responsibility of the Dual Program Committee and the student’s assigned advisor.

Eligible law students may receive up to 6 hours of credit toward the JD for acceptable performance in approved graduate-level courses offered by the College of Business Administration, the College of Engineering, or the College of Arts and Sciences. In addition graduate students may be eligible to take a limited number of law courses to count toward a graduate degree.

CONCENTRATION IN ADVOCACY AND DISPUTE RESOLUTION
Students interested in a concentration in advocacy and dispute resolution must complete the following courses
Second Year Fall Semester – 813, 920.
Third Year (one of the following) – 905, 908 and 914 or 947.
During the second and third year, any combination totaling 12 hours from the following courses – 821, 855, 877, 915, 916, 918, 921, 922, 923, 927, 990*, 991*. (*Only if approved by the Dean or Dean’s designee as satisfying the requirements of the concentration.)

Students electing a concentration in advocacy and dispute resolution may not take any of the above courses on an Satisfactory/No Credit basis.

CONCENTRATION IN BUSINESS TRANSACTIONS
Students interested in a concentration in business transactions must complete all of the following law courses.
818 Fundamental Concepts of Income Taxation
826 Introduction to Business Transactions*
827 Business Associations
972 Income Taxation of Business Organizations
940 Land Finance Law
840 Commercial Law
842 Contract Drafting Seminar
833 Representing Enterprises OR
978 Transactional Tax Planning
*This course is not required for students who have an undergraduate major in accounting, finance, or business administration, who hold the MBA, or who are enrolled in the dual JD-MBA program. Waivers may also be granted to students who have acquired the requisite business knowledge through other coursework or through practical experience.

DUAL JD-MBA PROGRAM
The College of Business Administration and the College of Law offer a coordinated dual program leading to the conferment of both the Doctor of Jurisprudence and the Master of Business Administration.

The establishment of the dual program recognizes the increasingly complex body of knowledge necessary to the creative conduct of business and business-related law practice, the complementary nature of many aspects of the graduate programs of the College of Law and the College of Business Administration, and the intellectual benefits inherent in the concurrent study of both business and business-related law. The program is designed to accommodate the interests of students who (a) contemplate a career in public service and want to acquire the skills and perspective of the lawyer and the business-oriented manager; (b) contemplate a career in business management and want to acquire the skills and perspective of a lawyer; or (c) contemplate a career as a lawyer specializing in business-related law and want to acquire the skills and perspective of the business-oriented manager.

Admission
Applicants for the JD-MBA program must make separate application, and be competitively and independently accepted by, the College of Law for the JD, the Office of Graduate and International Admissions and College of Business Administration for the MBA degree, and by the Dual Program Committee.

Students who have been accepted by both colleges may apply for approval to pursue the dual program anytime prior to, or after, matriculation in either or both colleges. Such approval will be granted, provided that dual program studies are started prior to entry into the last 28 hours of JD coursework and prior to the third semester of the MBA program. Students interested in entering the dual degree program should submit a letter of application to the Dual Program Committee. Upon receipt of the application, the Dual Program Committee will determine eligibility and assign students to advisors who will be responsible for course approval and supervision of the student’s progress through the dual program.

Requirements
A dual program candidate must satisfy the graduation requirements of each college. Students withdrawing from the dual program before completion of both degrees will not receive credit toward graduation from either college for courses in the other college, except as such courses qualify for credit without regard to the dual program.

The College of Law will award up to 9 hours of credit toward the JD for acceptable performance in approved graduate-level courses offered by the College of Business Administration. The College of Business Administration will award up to 6 hours of credit toward the MBA for acceptable performance in approved courses offered in the College of Law. The approval of courses is the responsibility of the Dual Program Committee and the student’s assigned advisor.

Students may begin their studies in either the JD or the MBA
program, but may not enroll in MBA coursework while completing the first year of the law curriculum and may not enroll in JD coursework while completing the first year of the business curriculum. During the first year in the JD program, students register through the College of Law. During the first year in the MBA program, students register as graduate students. After the first two years, any term in which students take law courses or a mixture of law and graduate courses, they are classified and registered as law students. If taking only graduate courses, they are classified and registered as graduate students.

**Approved Dual Credit**

MBA courses in which the student has earned a B grade or higher and are to be counted toward the JD program must include 9 hours approved by the College of Law. The 6 hours of law courses in which the student has earned a 2.30 or C+ grade or higher and are to be counted toward the MBA must be selected from those approved by the Assistant Dean of the MBA Program.

**DUAL JD-MPA PROGRAM**

The College of Law and the Department of Political Science in the College of Arts and Sciences offer a coordinated dual degree program leading to the conferral of both the Doctor of Jurisprudence and Master of Public Administration degrees. In this program, a student may earn the MPA and JD in about four years rather than the five years that otherwise would be required. Students pursuing the dual degree program should plan to be enrolled in coursework or an internship for one summer term in addition to taking normal course loads for four academic years.

**Admission**

Applicants for the JD-MPA program must make separate application to, and be independently accepted by, the College of Law for the JD and the Department of Political Science and the Office of Graduate and International Admissions for the MPA. Applicants must also be accepted by the Dual Degree Committee. All applicants must submit a Law School Admission Test (LSAT) score. An applicant’s LSAT score may be substituted for the Graduate Record Examination (GRE) score, which is normally required for admission to the MPA program. Application may be made prior to or after matriculation in either the JD or the MPA program, but application to the dual program must be made prior to entry into the last 29 hours required for the JD and prior to entry into the last 15 hours required for the MPA.

**Requirements**

A dual degree candidate must satisfy the requirements for both the JD and the MPA, as well as the requirements for the dual program. The College of Law will award a maximum of 9 hours of credit toward the JD for successful completion of approved graduate level courses (500 or 600 level) offered in the Department of Political Science. The MPA program will award a maximum of 9 hours of credit toward the MPA for successful completion of approved courses offered in the College of Law. All courses for which such cross-credit is awarded must be approved by the JD-MPA coordinators in the College of Law and the Department of Political Science. All candidates for the dual degree must successfully complete Administrative Law (Law 821). An internship is strongly recommended for students in the dual degree program, as it is for all MPA candidates, but an internship is not required.

During the first two years in the dual program, students will spend one academic year completing the required first year of the College of Law curriculum and one academic year taking courses solely in the MPA program. During those first two years, students may not take courses in the opposite area without the approval of the JD-MPA coordinators in both academic units. In the third and fourth years, students are strongly encouraged to take both law and political science courses each semester.

Dual degree students who withdraw from the program before completion of the requirements for both degrees will not receive credit toward either the JD or the MPA for courses taken in the other program except as such courses qualify for credit without regard to the dual program.

**Awarding of Grades**

For grade recording purposes in the College of Law and the Department of Political Science, grades awarded in courses in the other unit will be converted to either Satisfactory/No Credit and will not be computed in determining a student’s GPA or class standing. The College of Law will award a grade of Satisfactory for an approved MPA course in which the student earns a grade of B or higher and a grade of No Credit for any lower grade. The Political Science Department will award a grade of Satisfactory for an approved law course in which the student earns a grade of C+ or higher and a grade of No Credit for any lower grade. The official academic record of the student maintained by the Office of the University Registrar shall show the actual grade assigned by the instructor without conversion.

**Policy for Graduate Students Taking Law Courses**

Students pursuing a graduate degree in another college may, upon approval of the College of Law and the major chairperson, take up to 6 hours of law courses and receive credit toward the graduate degree. The graduate student must register for the law course during regular registration at the College of Law requesting an S/NC grade only. If a C or above is earned in a law course, an S will be recorded on the transcript. If a student earns below a C, an NC will be recorded, and the course cannot be used toward meeting degree requirements. Grades for law courses will not be reflected in the cumulative average. Law courses may be taken for credit only by students enrolled in a graduate degree program.

Different rules apply to the student enrolled in the Dual JD-MBA or JD-MPA Programs. Grades must be earned according to the grading system of the respective college, e.g. numerical grades for law courses, letter grades for graduate courses. Refer to section on Grades for the grading scale acceptable toward meeting degree requirements. Cumulative GPA for law courses only will be carried until graduation, at which time both the graduate and the law cumulates will be shown on the permanent record.
The College of Nursing was established in July 1971. The master’s program was initiated in 1976 and approval for the doctoral program was granted in 1988. For more information, contact the Director of MSN or PhD Program, The University of Tennessee, College of Nursing, 1200 Volunteer Boulevard, Knoxville, Tennessee 37996-4180; (865) 974-4151.

Facilities for research and service include the Center for Nursing Practice and the Center for Nursing Research.

### MAJOR OF SCIENCE IN NURSING

#### NURSING MAJOR

The College of Nursing program is accredited by the Collegiate Commission on Nursing Education that may be contacted at One Dupont Circle NW, Ste 530, Washington, DC 20036-1120, 1-202-887-6791, and is unconditionally approved by the Tennessee Board of Nursing.

The purpose of the master’s program in nursing is to prepare leaders, managers, and practitioners who facilitate achievement of optimal health in the dynamic health care system. The program prepares advanced practice nurses for a career in adult health nursing, nursing of women and children, mental health nursing, nurse anesthesia, and homeland security, as well as role preparation as nurse practitioners, clinical nurse specialists or nursing administrators. Advanced practice nursing involves the delivery of care, management of resources, interdisciplinary collaboration, and application of technology, information systems, knowledge, and critical thinking.

### DEGREES

#### MSN

- Adult health nursing concentration
- Family nurse practitioner concentration
- Homeland security nursing concentration
- Mental health nursing concentration
- Nurse anesthesia concentration
- Nursing administration concentration
- Nursing of women and children concentration

#### PhD

- Adult Health Nursing
- Family Nurse Practitioner
- Homeland Security Nursing
- Homeland Security Studies
- Mental Health Nursing
- Nurse Anesthesia
- Nursing Administration
- Nursing Education
- Nursing of Women and Children

### Graduate Certificate Programs

- Adult Health Nursing
- Family Nurse Practitioner
- Homeland Security Nursing
- Homeland Security Studies
- Mental Health Nursing
- Nurse Anesthesia
- Nursing Administration
- Nursing Education
- Nursing of Women and Children

### Professors

- Creasia, J., PhD, Maryland
- Farr, G., PharmD, Tennessee
- Hall, J., PhD, San Francisco
- Lee, J., PhD, Southern California
- McGuire, S., EdD, Tennessee
- Phillips, K., PhD, Tennessee
- Thomas, S., PhD, Tennessee

### Associate Professors

- Bell, D., DNSc, Tennessee
- Chen, S., PhD, Utah
- Davis, M., PhD, Tennessee
- Gaylord, N., PhD, Tennessee
- Shoffner, D., PhD, Tennessee
- Speraw, S., PhD, California

### Assistant Professors

- Beebe, L., PhD, Kentucky
- Brown, A., MSN, Alabama (Birmingham)
- Brown, M., PhD, Tennessee
- Callen, B., PhD, Wisconsin
- Evans, G., MSN, Tennessee
- Fields, B., PhD, Tennessee
- Gunther, M., PhD, Tennessee
- Helton, S., MSN, Texas Woman’s
- Kollar, M., PhD, Tennessee
- McLees, R., MSN, Tennessee
- Mefford, L., PhD, Tennessee
- Myers, C., PhD, Tennessee
- Nalle, M., PhD, Tennessee
- Pierce, M., DNP, Tennessee
- Roman, M., PhD, Kentucky
- Witucki, J., PhD, Tennessee
- Wyatt, T., PhD, Virginia

### MAJOR

### Nursing

- Adult health nursing concentration
- Family nurse practitioner concentration
- Homeland security nursing concentration
- Mental health nursing concentration
- Nurse anesthesia concentration
- Nursing administration concentration
- Nursing of women and children concentration

http://nightingale.con.utk.edu
Graduates of the program are expected to

- Provide advanced nursing care in a variety of health care settings.
- Utilize theoretical knowledge to guide advanced practice nursing.
- Collaborate in research activities and utilize knowledge gained from research in advanced practice nursing.
- Evaluate health policies and economics related to delivery of health care.
- Assume roles as leaders and collaborators with other professionals and communities in planning, providing, and evaluating health care.

Admission

- Meet requirements for admission to graduate study.
- Achieve a competitive score on the combined verbal and quantitative portions of the Graduate Record Exam.
- Achieve a TOEFL score of at least 550 on the paper test, 213 on the computer-based test, or 80 on the Internet-based Test if native language is not English.
- Hold a bachelor's degree in a discipline other than nursing (Bachelor of Science in Nursing) from an accredited program.
  a. Hold or be eligible for licensure to practice nursing in Tennessee.
  b. Have an undergraduate GPA of 3.00 or higher on a 4-point scale, or a GPA of 3.30 for courses in the undergraduate major.
  c. Have completed a health assessment course.
  d. Have completed 3 hours of graduate-level statistics.

OR

- Hold a bachelor's degree in a discipline other than nursing (master's entry student or RN) from an accredited college or university.
  a. Have a cumulative undergraduate GPA of at least 3.00 on a 4-point scale.
  b. Have satisfactorily completed the following prerequisite courses: chemistry (8 hours); microbiology (including lab); anatomy and physiology (6 to 8 hours); nutrition (covering lifespan in health and illness); social sciences (9 hours) and a general psychology course (3 hours); undergraduate research course or equivalent; 3 hours of graduate-level statistics prior to enrollment in graduate research course.
  c. Nurse anesthesia option not available to master's entry students.
  d. Application and admission dates vary. BSN graduates and RN students apply by February 1 for admission for the following fall term. Post-master's applications must be received by October 1 for the following spring admission date. Masters-entry students apply by October 1 for the following summer admission date.

Non-Degree Status

Only 505 and 511 are open to students in Non-Degree Status. Students not yet accepted into the master’s program must be advised by the Chair of the Master of Science in Nursing program prior to enrollment.

Special Requirements

- Before enrollment in the master’s program, each student must successfully complete a criminal background check.
- Each student must hold personal professional liability insurance and health insurance.
- Registered nurses must be eligible to practice nursing in Tennessee, i.e., licensed in Tennessee or one of the interstate compact states.
- Each student must present proof of hepatitis B vaccination and rubella and rubeola immunization or sufficient titer for immunity; TB status.
- Each student must present evidence of current two-person CPR certification.
- Non-registered nurse students must have completed courses in chemistry, nutrition, microbiology, anatomy, and physiology plus 12 hours of behavioral science courses.
- For more detailed information about the application process, contact Master of Science in Nursing Program, The University of Tennessee College of Nursing, 1200 Volunteer Boulevard, Knoxville, Tennessee 37996-4180; (865) 974-0591.

Thesis and Non-Thesis Options

The thesis option is available for interested students and is especially encouraged for those who are considering pursuit of doctoral degrees sometime in the future. Students who choose the non-thesis option must register for Nursing 582.

Program Requirements

<table>
<thead>
<tr>
<th>Core (7 hours)</th>
<th>Hours Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>507 Concepts for Advanced Practice Nursing: Health Promotion and Health Policy</td>
<td>4</td>
</tr>
<tr>
<td>510 Theoretical Foundations of Nursing</td>
<td>3</td>
</tr>
</tbody>
</table>

Advanced Practice Core (9 hours) *

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>504 Advanced Health/Physical Assessment</td>
<td>3</td>
</tr>
<tr>
<td>505 Advanced Clinical Pharmacology</td>
<td>3</td>
</tr>
<tr>
<td>515 Advanced Pathophysiology for Nursing Practice</td>
<td>3</td>
</tr>
</tbody>
</table>

* Not required for nursing administration concentration or homeland security (Management Track).

Required for nurse anesthesia students

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>506 Advanced Anesthesia Pharmacology</td>
<td>3</td>
</tr>
<tr>
<td>516 Advanced Pathophysiology: Neurological/Cardiovascular with Anesthesia Implications</td>
<td>2</td>
</tr>
<tr>
<td>517 Advanced Pathophysiology: Respiratory/Renal with Anesthesia Implications</td>
<td>2</td>
</tr>
<tr>
<td>518 Advanced Pathophysiology: Obstetrical and Pediatric Pathophysiology with Anesthesia Implications</td>
<td>2</td>
</tr>
<tr>
<td>523 Advanced Principles of Nurse Anesthesia Practice</td>
<td>2</td>
</tr>
<tr>
<td>524 Basic Principles of Anesthesia I</td>
<td>3</td>
</tr>
<tr>
<td>525 Basic Principles of Anesthesia II</td>
<td>3</td>
</tr>
<tr>
<td>526 Professional Issues in Nurse Anesthesia</td>
<td>2</td>
</tr>
</tbody>
</table>

Research (6-9 hours)

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 Thesis</td>
<td>6</td>
</tr>
<tr>
<td>582 Scholarly Inquiry for Advanced Practice Nursing</td>
<td>3</td>
</tr>
</tbody>
</table>

Concentration (choose one)

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>529, 530, 531 Adult Health</td>
<td>13</td>
</tr>
<tr>
<td>529, 538-539 Adult Health: Gerontology</td>
<td>13</td>
</tr>
<tr>
<td>544-545-546-547-548-549 Clinical Nurse Anesthesia Practicum Seminar I, II, III, IV, V, VI</td>
<td>40</td>
</tr>
<tr>
<td>532, 533, 534, 535, 536, 537 Homeland Security: Advanced Practice</td>
<td>31</td>
</tr>
<tr>
<td>532, 533, 534, 537 Homeland Security: Management</td>
<td>16</td>
</tr>
<tr>
<td>550-551-553-554-555-556 Nursing of Women and Children: Women's Health</td>
<td>20</td>
</tr>
<tr>
<td>550-551-552-556-562-563 Nursing of Women and Children: Child Health</td>
<td>20</td>
</tr>
<tr>
<td>560-561-519 Mental Health Nursing I, II</td>
<td>16</td>
</tr>
<tr>
<td>570-571-572-573 Family Nurse Practitioner I, II, III</td>
<td>19</td>
</tr>
<tr>
<td>590-591 Nursing Administration: Macro/Micro Analysis</td>
<td>12</td>
</tr>
</tbody>
</table>
Additional Course Requirements

Electives for nursing administration concentration .................................................. 9
Electives for homeland security nursing: management track .................................. 3
Epidemiology for homeland security nursing: management and advanced practice tracks .................................................. 3
Issues in Advanced Practice (all concentrations except nurse anesthesia) .......... 1
Advanced Practice Role Seminar (for masters-entry students) ......................... 1

Students who enter the program as non-RNs must complete the following undergraduate nursing courses in addition to meeting the requirements listed above.

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>310 Essentials of Nursing Practice</td>
<td>3</td>
</tr>
<tr>
<td>319 Pathophysiology of Health Deviations</td>
<td>4</td>
</tr>
<tr>
<td>333 Health Assessment</td>
<td>3</td>
</tr>
<tr>
<td>342 Transcultural Issues</td>
<td>2</td>
</tr>
<tr>
<td>351 Pharmacology I</td>
<td>2</td>
</tr>
<tr>
<td>361 Health Maintenance and Restoration: Adult</td>
<td>5</td>
</tr>
<tr>
<td>406 Pharmacology II</td>
<td>2</td>
</tr>
<tr>
<td>415 Nursing the Childbearing Family</td>
<td>4</td>
</tr>
<tr>
<td>421 Health Maintenance and Restoration in Mental Health</td>
<td>5</td>
</tr>
<tr>
<td>432 Health Promotion and Maintenance Strategies in the Community</td>
<td>3</td>
</tr>
<tr>
<td>444 Care of Children, Adolescents, and Their Families</td>
<td>3</td>
</tr>
<tr>
<td>454 Professional Leadership Issues</td>
<td>2</td>
</tr>
<tr>
<td>461 Health Restoration: Adult</td>
<td>4</td>
</tr>
</tbody>
</table>

Registered nurses whose bachelor’s degrees are not in nursing must have completed courses in chemistry, nutrition, microbiology, anatomy, and physiology plus 12 hours of behavioral science courses. They must also complete 305, 382, and 454 and complete or successfully challenge the following.

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>311 Foundations of Professional Nursing Practice</td>
<td>5</td>
</tr>
<tr>
<td>319 Pathophysiology of Health Deviations</td>
<td>4</td>
</tr>
<tr>
<td>333 Health Assessment</td>
<td>3</td>
</tr>
<tr>
<td>351 Pharmacology I</td>
<td>2</td>
</tr>
<tr>
<td>361 Health Maintenance and Restoration: Adult</td>
<td>5</td>
</tr>
<tr>
<td>404 Health Promotion, Maintenance, and Restoration in Children, Adolescents, and their Families</td>
<td>5</td>
</tr>
<tr>
<td>406 Pharmacology II</td>
<td>2</td>
</tr>
<tr>
<td>421 Health Maintenance and Restoration in Mental Health</td>
<td>5</td>
</tr>
<tr>
<td>461 Health Restoration: Adult</td>
<td>4</td>
</tr>
<tr>
<td>494 Alternative Preceptorship</td>
<td>4</td>
</tr>
</tbody>
</table>

A total of 24 hours can be obtained by successful completion of the NLN ACE Examination. See undergraduate catalog for other challenge options. RNs who are in the process of completing a BSN at the University of Knoxville, with the intent of enrolling in the MSN program, follow the same plan with the addition of 471.

Final Examination Requirements

All students must successfully complete a final examination as required by the Graduate Council. For thesis students, the examination will consist of an oral defense of the thesis as well as other written or oral questions designed to measure student mastery of the entire program of study. For non-thesis students, the written examination will cover the entire program of study and may, at the discretion of the student’s committee, be followed by an oral examination.

Special Policies

- If the clinical performance of any student for any course is found to be unsatisfactory, the student will receive a grade of F for the course.
- If a student achieves a final grade of D or F for any required undergraduate or graduate nursing course, he or she will not be permitted to repeat the course and will be required to withdraw from the program.
- If the clinical performance of any student is characterized by unethical, unprofessional or unsafe behavior, or behavior that places the client in jeopardy, the student will be required to withdraw from the program.
- Students are expected to maintain a 3.00 cumulative GPA; however, students must maintain a grade of B or better in clinical concentration courses and/or directed clinical practice. Graduate students are not permitted to repeat a course, repeat an exam or do additional work for the purpose of raising a grade already received. A student who receives a final grade below a B in a clinical concentration course will be dismissed from the program. A student whose cumulative GPA drops below a 3.00 as a result of earning grades of C in other courses will be placed on academic probation. A student will be allowed to continue in graduate study while on academic probation as long as each semester’s grade point average is 3.00 or better and the grade for clinical concentration work is at least 3.00.

RN-MSN Track

The RN-MSN track provides an opportunity for qualified associate degree and diploma-prepared nurses to obtain the MSN.

Admission

- Associate degree or diploma in nursing.
- Minimum grade point average 3.00 (on 4 point scale) for all pre-professional course requirements.
- Eligible to practice as a registered nurse in Tennessee (licensed as an RN in Tennessee or one of the interstate compact states).
- Have satisfactorily completed the following prerequisite courses – chemistry (8 hours); microbiology (including lab); anatomy and physiology (6 to 8 hours) nutrition covering lifespan in health and illness; social sciences (9 hours) and a general psychology course (3 hours).
- Three professional letters of reference.
- Personal statement of goals and objectives.

Prior to Admission to Graduate Program

- Complete the BSN with at least a 3.00 GPA.
- Achieve a competitive score on the combined verbal and the quantitative portions of the Graduate Record Examination.

Bachelor of Science in Nursing Courses

- RN’s are exempt from sophomore level Nursing 201 (Introduction to Nursing) and will be given proficiency credit based on RN status.
- RN students will take the NLN Acceleration Challenge Exams prior to starting upper division coursework. If a decision score of 100 is achieved (per section), the student will receive proficiency credit for Nursing 361, 403, 404, 421, and 461.
- Proficiency credit can also be obtained in courses marked with an asterisk(*) in the following section.

Bachelor of Science in Nursing Degree

- A baccalaureate degree in nursing will be awarded upon completion of all required level 300 and 400 courses.
- A total of 123 undergraduate hours are required for the baccalaureate degree with the last 30 hours completed in residence at the University of Tennessee, Knoxville.

RN-MSN students will complete (or challenge*) the following courses, prior to beginning MSN courses.
DOCTOR OF PHILOSOPHY
NURSING MAJOR

The College of Nursing offers a doctoral program leading to the Doctor of Philosophy degree with a major in nursing. The dissertation must be completed in its entirety at one site. The doctoral program prepares nursing scholars capable of integrating research, theory, and practice into their roles as researchers, educators, and/or administrators. Specifically, the graduate of this program should be able to:

- Analyze, test, refine, and expand the theoretical basis of nursing.
- Conduct research that generates knowledge and advances nursing as a discipline.
- Provide leadership as nurse scientists who can function in a variety of roles and settings.
- Collaborate with members of other disciplines in health-related research.
- Develop, implement, evaluate, and recommend health care policy.
- Demonstrate professionalism, advocacy, ethical principles and scientific integrity.

Admission

- Meet requirements for admission to graduate study.
- Hold a master’s degree in nursing from a program accredited by the National League for Nursing Accrediting Commission or the Commission on Collegiate Nursing Education. Some outstanding applicants who are prepared at the bachelor’s level in nursing may be considered. In such cases, graduate level courses in nursing theory, concentration specialty, and/or research will be integrated into the formal program of doctoral degree requirements.
- Have a minimum cumulative graduate grade point average of 3.30 on a 4.00 scale for previous college work.
- Achieve a competitive score on the combined verbal and quantitative portions of the Graduate Record Exam.
- Have successfully completed a basic statistics course and graduate nursing theory and research courses prior to enrollment in nursing doctoral level courses.
- Have TOEFL score of at least 550 on the paper test, 213 on the computer-based test, or 80 on the Internet-based Test if native language is not English.
- Complete Graduate Program Data Form, College of Nursing.
- Submit Graduate Rating Forms from three college level instructors and/or nurses and administrators who have supervised applicant’s professional work.
- Submit a sample of scholarly writing (e.g., thesis, published paper).
- Submit an essay describing personal and professional aspirations.
- Submit Graduate Application for Admission, academic transcript, Graduate Record Examination scores, and, if required, TOEFL scores to the Office of Graduate and International Admissions. Submit three Graduate Rating Forms, sample of scholarly writing, and Graduate Program Data Form with essay to the Director of the PhD program prior to November 1 of the year prior to fall admission.

- Schedule a personal interview with the College of Nursing PhD Student Admissions Committee prior to March 15 of the year preceding fall admission. International applicants may be interviewed by telephone or teleconferencing at the discretion of the admissions committee.

Requirements

The following courses are required for all students.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Hours Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>601</td>
<td>Philosophy and Theory for Nursing Science</td>
<td>3</td>
</tr>
<tr>
<td>603</td>
<td>Nursing Research and Inquiry</td>
<td>3</td>
</tr>
<tr>
<td>605</td>
<td>Middle-Range Theoretical Formulations for Nursing Science Development</td>
<td>3</td>
</tr>
<tr>
<td>606</td>
<td>Nursing Research Seminar</td>
<td>3</td>
</tr>
<tr>
<td>607</td>
<td>Qualitative Nursing Research</td>
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</tr>
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<td>608</td>
<td>Quantitative Nursing Research</td>
<td>3</td>
</tr>
<tr>
<td>609</td>
<td>Research Practicum</td>
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<tr>
<td>610</td>
<td>Nursing Science Seminar</td>
<td>2</td>
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<tr>
<td>612</td>
<td>Health and Nursing Policy/Planning</td>
<td>3</td>
</tr>
<tr>
<td>613</td>
<td>Nursing Leadership in Complex Systems</td>
<td>3</td>
</tr>
<tr>
<td>-</td>
<td>Inferential Statistics</td>
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<tr>
<td>-</td>
<td>Multivariate Statistics</td>
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<tr>
<td>-</td>
<td>Cognates**</td>
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<td>-</td>
<td>Elective</td>
<td>3</td>
</tr>
<tr>
<td>600</td>
<td>Dissertation</td>
<td>24</td>
</tr>
</tbody>
</table>

*Note: One hour per semester, must be taken for two semesters. **Possible cognate areas include, but are not limited to, anthropology, child and family studies, psychology, education, management, public health, social work, philosophy, and statistics.

Doctoral Committee

Early in the student's program, a nursing faculty advisor will be selected by the student in consultation with the program director. The student’s comprehensive examination committee consists of the faculty teaching core courses and one representative from the cognate area. The student then selects the dissertation committee. Four faculty, holding the rank of assistant professor or above, comprise the committee, three of whom (including the chair) must be approved by the Graduate Council to direct doctoral dissertations. At least one member of the committee must be from an academic unit other than nursing.

Special Policies

- A maximum of 6 graduate hours taken before acceptance into the doctoral program may be applied toward the degree.
- Prior to enrollment in the PhD program, each student must successfully complete a criminal background check.
- A minimum grade of B in all nursing doctoral courses and a 3.00 cumulative GPA are required for continuation in the program.

Intercollegiate/Interdisciplinary Gerontology Minor

Graduate students in the College of Nursing may pursue an intercollegiate/interdisciplinary minor in gerontology. The gerontology minor gives the student an opportunity for combining knowledge about aging in American society with his/her major concentration.

Core courses and a practicum are offered by the College of Social Work and selected departments within the Colleges of Education, Health, and Human Sciences and Arts and Sciences. A cross-listed seminar between contributing programs is designed to integrate experiences from different sources and to demonstrate the multi-faceted nature of working within an aging society. Please refer to the College of Education, Health, and Human Sciences for specific requirements.
Nursing Education Minor

Graduate students in the College of Nursing may pursue a nursing education minor. The minor consists of 12 hours – 6 hours in nursing and 6 in education. Required courses in the College of Nursing are 566 and 565. In consultation with the Nursing Education Minor Coordinator, students select 6 hours of coursework from the College of Education, Health, and Human Sciences.

GRADUATE CERTIFICATES

The College of Nursing offers certificates for nurses who need additional training. A master’s degree in nursing is required for admission.

The total hours will vary depending on the student’s academic record, clinical experience, and objectives. Students must complete a minimum of 12 hours. Most students complete 16-20 hours of course credit with the exception of those pursuing certificates in homeland security, nurse anesthesia, or women and children: neonatal, where additional hours are required. The nurse anesthesia certificate program requires students who have completed the master’s degree in nursing within the preceding five years to complete 60-70 hours of course credit. Contact the MSN chair for more information.

• ADULT HEALTH NURSING
  Course requirements are 529, 530, and 531, or for those pursuing gerontology, course requirements are 529, 538, and 539, plus additional hours as determined by the college.

• FAMILY NURSE PRACTITIONER
  Course requirements are 570, 571, 572, and 573 plus additional hours as determined by the college.

• HOMELAND SECURITY NURSING
  Course requirements are 532, 533, 535, 536, 537, 592, epidemiology, one related elective, plus additional hours as determined by the college.

• HOMELAND SECURITY STUDIES
  The interdisciplinary graduate certificate in homeland security studies is available to those who seek to gain specialized knowledge and skills related to the prevention and management of catastrophic incidents or large scale public health emergencies that result in mass casualties, whether the cause is naturally occurring, accidental, or terrorism. Admission to the certificate program is selective and requires either admission to the University of Tennessee graduate degree seeking program or an earned master’s degree in any relevant field, as well as relevant work experience. A degree in nursing is not required. The certificate program is composed of 24 hours: Nursing 532 (3), Nursing 533 (5), Nursing 534 (5), Nursing 537 (3), Nursing 592 (2), graduate-level epidemiology (3 hours), and an approved elective (3 hours).

• MENTAL HEALTH NURSING
  Course requirements are 519, 560, and 561, plus additional hours determined by the college.

• NURSE ANESTHESIA
  In addition to the general requirements for admission to graduate study and the College of Nursing, the following are required of all nurse anesthesia certificate applicants.
  • One year of critical care experience with adult clients.
  • Certification in Advanced Cardiac Life Support (ACLS) and Pediatric Advanced Life Support (PALS).
  • A personal interview.

Course requirements are 506, 516, 517, 518, 522, 523, 524, 525, 526 of nurse anesthesia didactic content, plus additional hours as determined by the college and 54 hours of nurse anesthesia clinical practice courses, 544, 545, 546, 547, 548, 549, 583.

• NURSING ADMINISTRATION
  Course requirements are 590 and 591, plus additional hours as determined by the college.

• NURSING EDUCATION
  The post-master’s certificate in Nursing Education consists of 12 hours – 6 hours in nursing and 6 in education. Required courses in the College of Nursing are 566 and 565. In consultation with the Nursing Education Minor Coordinator, students select 6 hours of coursework from the College of Education, Health, and Human Sciences.

• NURSING OF WOMEN AND CHILDREN
  Course requirements for Women and Children: Pediatrics are 550, 551, 527, 528, 562, 563, plus additional hours as determined by the college; for Women and Children: Women’s Health are 550, 551, 553, 554, 555, 556, plus additional hours as determined by the college; for Women and Children: Neonatal are 550, 551, 552, 564, 567, 568, 569, plus additional hours as determined by the college.
The College of Social Work began as the Nashville School of Social Work, founded in 1942 under the auspices of Vanderbilt University, Scarritt College, and George Peabody College. It joined the University of Tennessee in 1951. By 1974 the three branches, located in Nashville, Memphis and Knoxville, offered the two-year master’s program. The doctoral program was inaugurated in 1983. In 1985 the Bachelor of Science in Social Work program was added, and the School achieved college status.

The University of Tennessee College of Social Work offers the full continuum of social work education degrees at the baccalaureate, master’s and doctoral levels.

Social work is a helping profession that focuses on providing skilled intervention in the prevention and amelioration of individual and societal problems. It is the purpose of the college to provide an education that fosters growth in both individual and career development.

Graduate Programs

The two-year program (thesis or non-thesis option) leading to the Master of Science in Social Work is fully accredited by the Council on Social Work Education and is offered on all three campuses. The foundation curriculum of the PhD program is available only in Knoxville. The interdisciplinary graduate certificate in gerontology at the University of Tennessee, offered on all three campuses, prepares graduate students to work with and on behalf of the rapidly growing older population. The gerontology certificate gives students the opportunity to combine interdisciplinary courses concerning critical aging issues with direct aging-related experiences. The graduate certificate in gerontology consists of 21 credit hours - 3 required classes (9 hours), 2 elective classes (6 hours) and 6 hours of an aging-related internship. Courses may be used to count toward both the MSSW and the gerontology certificate if they fulfill requirements of both programs. With proper planning, one can complete both programs of study in a two-year (full-time) period. The completion of the certificate is formally noted on the student’s transcript and indicates

http://www.csw.utk.edu/
to prospective employers that, in addition to training within a particular discipline and degree program, formal interdisciplinary training in gerontology has been obtained. The Tennessee State School Social Work Licensure Program at the University of Tennessee College of Social Work is available to currently enrolled bachelor's level and master's level students as well as persons who already hold a bachelor's and/or master's degree in social work from an accredited social work program. Information and application materials are available from the College of Social Work, Henson Hall, Knoxville, Tennessee 37996-3333.

Financial Aid

Students may apply directly to the university’s Office of Financial Aid and Scholarships for assistance such as the National Direct Student Loan or the Work-Study Program.

Information regarding scholarships administered by the college is made available after admission. Financial aid is available to qualified students in the form of fellowships, scholarships, and teaching and research assistantships. Graduate assistantships and other forms of assistance are awarded on the basis of merit and interest to applicants who are accepted into the PhD program.

MASTER OF SCIENCE IN SOCIAL WORK

SOCIAL WORK MAJOR

The college offers a new MSSW curriculum that is informed by state-of-the-art, cutting-edge knowledge and grounded upon core social work values and ethics. The concepts of critical thinking and evidenced-based practice, complexity, culturally affirming practice, social and economic justice, and at-risk populations permeate the new MSSW curriculum. The MSSW program seeks to prepare MSSW graduates to make demonstrable improvements in the quality of life of at-risk and vulnerable populations across individuals, families, groups, organizations, communities, the state of Tennessee, the nation and internationally.

EVIDENCE-BASED PRACTICE ACROSS SYSTEMS CONCENTRATION (EBPAS)

Evidence-based practice across systems (EBPAS) is a population-focused concentration, based on the underlying principle of social and economic justice, of vertically and horizontally integrated practice. EBPAS practitioners assess and promote the social well-being of at-risk and diverse populations, and client systems across the life cycle and across practice settings. EBPAS practitioners may work in a variety of settings, including, for example, schools, health care, prevention, community-based organizations, social and economic development organizations, and the political arena, with client systems and populations including children/youth, families, and older adults.

The goal of this concentration is to produce social workers who are critical thinkers in ethically-sound, systemic, skill-based, evidence-based practice including activities such as, but not limited to, social and economic development, planning, organizing, coordinating, developing, and evaluating direct and indirect activities for targeted at-risk populations, clients, and client systems, and the use of information technology. The concentration builds on the foundation curriculum preparing students to identify issues and contributing determinants, and to logically develop and implement interventions, plan objectives and evaluate outcomes.

The knowledge, skills, and competencies acquired by students in this concentration produce practitioners who are prepared to work as professionals on transdisciplinary teams and in interdisciplinary settings, to deliver, develop, manage and evaluate programs and direct services, acquire funding, write grants, analyze and advocate for policy change in political systems, organizations, and communities both within and outside the U.S.

EVIDENCE-BASED INTERPERSONAL PRACTICE CONCENTRATION (EBIP)

The evidence-based interpersonal practice concentration prepares students for professional social work practice with individuals, groups, children/youth, and families. The goal of the concentration is to utilize evidence-based practices for the restoration, maintenance, and promotion of social functioning. Change objectives focus on the transactional relationships between individuals, groups, and families and their social environment.

The EBIP concentration prepares students for ethically informed direct practice with diverse populations. Students develop competencies in advanced assessment, relationship building/enhancement, application of goal-oriented and evidence-based interventions, evaluation of practice, and life-long professional development. Potential areas of practice include mental health, child welfare, substance abuse, health care, and other settings providing services to populations at risk.

Admission

Admission to the master’s program is based on the following.

• A bachelor’s degree from an accredited college or university with appropriate preparation in the social sciences. At least three-fourths of the applicant’s undergraduate work should be in the social sciences, humanities, physical sciences, and other arts and sciences subjects. Applicants must demonstrate a liberal arts perspective through coursework in at least four of the following five areas – economics or mathematics; government, political science or history; sociology or anthropology; psychology; philosophy, literature, or the arts. Applicants with other academic backgrounds may request consultation to discuss ways that they can meet the requirements.

• A grade point of 2.70 or higher on a 4.00 scale. Applicants failing below this average may be considered for probationary admission on the basis of supplemental evidence of the ability to perform at a satisfactory level. The university requires a minimum GPA of 2.70 for admission to graduate study.

• Personal qualifications acceptable for entrance into the professional practice of social work.

• All applicants must submit up-to-date scores from the Graduate Record Examination (general).

Preference is given to applicants with a GPA of 3.00 or above in their undergraduate work with substantial preparation in the social sciences. Applicants who have a prior conviction, other than a minor traffic violation, may not necessarily be denied admission to the MSSW program. However, such convictions may prevent placement in certain field practice agencies and/or licensure in certain states.

Advanced Standing

The University of Tennessee College of Social Work has an advanced standing program. Admission to advanced standing requires a BSW from an accredited program; an overall undergraduate GPA of 3.00 or higher; and personal qualifications acceptable for entrance into the professional practice of social work. These students will follow the curriculum plan and meet all requirements of the concentration during three semesters of study in the program.

Application for admission to the advanced standing program is through the regular admission process.

Extended Study

Planned part-time programs are available in all three locations of the college. Admission requirements are the same as for full-time study. Coursework can be completed over a three- or four-year period.
Transfer Credits

Coursework equivalent to the first year of the master’s pro-
gram, completed in another accredited graduate social work pro-
gram, is usually accepted toward degree requirements. Appli-
cants must meet the admission requirements of the Graduate
Council and the College of Social Work. Transfer courses must
be approved as equivalent to required and/or elective courses
taken for graduate credit and passed with a grade of B or better.
An S (Satisfactory/No Credit system) for the field practicum
is also accepted. In addition, transfer courses must be part of an
otherwise satisfactory graduate program (B average) and be ac-
cepted by the dean. This coursework must be completed within
the six-year period prior to the receipt of the degree.

A maximum of 6 hours from work earned in disciplines other
than social work may be transferred as elective credits. The stu-
dent’s academic committee must approve the request and the
transfer credit must meet Graduate Council requirements.

Proficiency Examination

Students interested in proficiency examinations are referred to
the College of Social Work Student Handbook statement de-
scribing the procedure for applying for examination and the ap-
licable courses.

Requirements

- The program requires successful completion of a mini-
mum total of 60 semester hours.
- Students may select a thesis or non-thesis option. Stu-
dents pursuing the thesis option receive 6 hours for suc-
cessful completion.
- Students must successfully complete a comprehensive
  exam or thesis defense.
- Students must have an overall GPA of 3.00 or better on all
  graded courses and satisfactory performance in field.

Professional Foundation Curriculum

MSSW foundation content (first year – fall and first half of
spring semester) includes fundamental, evidence-based knowl-
edge and skills that will prepare students to practice across client
systems within a culturally affirming generalist social work con-
text. MSSW foundation curriculum includes content in the follow-
ing areas – social work practice, research, human behavior in the
social environment, social policy, populations at risk and social
and economic justice, values and ethics, diversity, critical think-
ing/evidenced-based practice, and field.

Field Practice

The application of knowledge and skills is a critical aspect of a
competency based, practice-oriented MSSW curriculum. The op-
portunity for students to practice and learn in experiential settings
is provided through collaboration between the college and a wide
range of social service organizations. This effort between the part-
ners produces effective experiences that enhance the students’
professional development in their individual practice areas. Op-
portunities designed to meet the field practice requirement are
available within Tennessee, in certain other parts of the country,
and in selected international locations. Field practica are offered
either concurrently with class instruction or in block format.

Foundation placements are selected through a joint process
involving the student, the field coordinator, and personnel from
potential internship sites. These first placements are designed to
provide students with supervised generalist practice experience,
which is consistent with the generalist knowledge and skill devel-
opment education they receive in the classroom. Accordingly,
students’ experiences are planned and designed to meet specif-
ic foundation educational objectives. Concentration internships
build on the generalist foundation. The concentration practicum
provides supervision in a practice setting selected with attention
to a student’s practice interest, individual career interests, and
educational needs. As with the foundation placement, students
actively participate with the field coordinator and potential agency
field instructors to select their concentration placement site. The
concentration field placement experience focuses on the integra-
tion of social work knowledge and values while emphasizing the
acquisition and development of advanced practice skills built on,
but distinct from generalist, foundation skills.

Students receiving a grade of NC in field practice may not re-
peat the field practice.

Advanced Content

All MSSW students begin to take core advanced required courses
in the second session of spring semester during their first year of study. These advanced required courses include con-
tent in leadership, supervision, management, introductory psy-
chopathology, and advanced knowledge for evidence-based
practice. These courses are embedded in an understanding of the
complex ways that risk and resilience interact across the lifespan and systems to enhance well being.

DOCTOR OF PHILOSOPHY

SOCIAL WORK MAJOR

The College of Social Work offers the Doctor of Philosophy
with a major in social work.

The focus of social work education at the doctoral level is to
foster the development of an attitude of scientific inquiry, knowl-
edge of the scientific method, ability to extend the knowledge
base of social work practice, and effective participation in leader-
ship roles in social work education, research, and practice.

The emphasis of the doctoral program is upon

- The analysis of direct intervention and social administra-
tion and of the interrelationships among each of them and
their social policy, organizational, and community contexts.
- Research-based knowledge to inform and guide social
work practice, social policy, and social welfare program
development.

The program consists of foundation courses, elective cours-
es, and dissertation research. The courses are available only in
Knoxville. Students and their committees can develop a plan for
completing their research in Nashville and Memphis based on
the availability of dissertation resources.

Students have the opportunity to work in the Children’s Men-
tal Health Services Research Center as part of their training. The
center focuses on services to children who have experienced
mental health problems associated with abuse, neglect, violence
and a variety of psychosocial problems.

Admission

The PhD program is designed for students who have com-
pleted a master’s degree in an accredited school of social work
and have post-master’s social work/social welfare experience.
Applicants who do not meet these requirements, but believe they
have equivalent credentials should contact the chair of PhD pro-
gram for further information regarding admissions criteria.

Applications may be downloaded at www.csw.utk.edu/phd.

Requirements

A minimum of 66 hours beyond the master’s degree including
the following.

- Completion of 27 hours of required coursework.
- Completion of 15 hours of advanced electives, at least 12
  of which are taken outside the department, and 9 of those
  12 related to the dissertation.
- Completion of at least 24 hours of dissertation research.
- Successful completion of qualifying and comprehensive
  examinations.
• Completion and defense of the dissertation.

The curriculum of the PhD program consists of foundation coursework, electives, and dissertation research. The foundation curriculum consists of 27 hours of coursework in the history and philosophy of social work, issues in direct service and administration and planning, areas of practice, and research methodology and statistics. Upon this foundation, students and their academic committees develop a plan of study consisting of coursework in social work and other departments of the university.

Typically, the 24 hours of foundation curriculum are completed and elective coursework begun during the first year of study Social Work 670 and the elective requirement are completed and dissertation research begun in the second year of study. Dissertation research is continued in the third year of study. While it is generally expected that the coursework will be completed on a full-time basis, dissertation research can be completed on a planned part-time basis.

Specific courses required are 601, 602, 612, 613, 640, 650, 670, and Statistics 531 and 532 or any two graduate level statistics courses approved by the doctoral program chair.

Examinations

All doctoral students are required to pass a qualifying examination and a comprehensive examination. The qualifying examination covers the foundation curriculum. The comprehensive examination is administered by members of the comprehensive exam committee and is designed for the student to demonstrate comprehensive knowledge of the major and cognate areas and the dissertation topic. In case of failure of either examination, the student may request a retake. The result of the second examination is final.

Intercollegiate/Interdisciplinary Gerontology Minor

Graduate students in the College of Social Work, at the Knoxville location, may pursue an intercollegiate/interdisciplinary minor in gerontology. The gerontology minor gives the student an opportunity for combining the knowledge about aging in American society with his/her major concentration.

Core courses and a practicum are offered by the College of Social Work and selected departments within the Colleges of Education, Health, and Human Sciences and Arts and Sciences. A cross-listed seminar between contributing programs is designed to integrate experiences from different sources and to demonstrate the multi-faceted nature of working within an aging society. Please refer to the College of Education, Health, and Human Sciences for specific requirements.
MAJOR

Veterinary Medicine

DEGREE

DVM

The College of Veterinary Medicine, established in 1974, offers a professional curriculum leading to the Doctor of Veterinary Medicine (DVM) degree. Residency training programs in the various clinical specialties are also offered.

The primary objective of the college is to enable students to attain essential information, skills, attitudes and behaviors to meet the varied needs of society and the veterinary profession. The professional curriculum provides an excellent basic science education in addition to training in diagnosis, disease prevention, medical treatment, and surgery. Graduates are qualified to pursue careers in the many facets of veterinary medicine and related health professions.

About two-thirds of the veterinarians in the United States are engaged exclusively in pet or companion animal practice. A growing number are concerned with the health problems of zoo animals, laboratory animals, wildlife, and aquatic species. A number of veterinarians are involved in the health care of food and fiber animals ensuring the supply of safe and healthy food.

Veterinarians also find rewarding careers in the U.S. Public Health Service, the Armed Forces, and in state, county, or local health agencies. A large number of veterinarians are employed by the U.S. Department of Agriculture and by state departments of agriculture for important work in livestock disease control, meat and poultry inspection, serum and vaccine production, and the protection of our country against the importation of foreign animal diseases. With the events of September 11, 2001, veterinarians are making significant contributions to biosecurity and homeland defense.

Excellent research opportunities exist for veterinarians – research directly benefiting animals and research conducted with animals that benefits humans. Such opportunities are available at colleges and universities and with governmental agencies, private research institutions and biological and pharmaceutical companies.

The college jointly administers a graduate program leading to the Master of Science and the Doctor of Philosophy degrees with a major in comparative and experimental medicine. This program provides a wide spectrum of interdisciplinary training that prepares graduates for teaching and/or research careers in the health sciences. The majority of the graduate students and graduate faculty of the College of Veterinary Medicine are involved in the comparative and experimental medicine program. (See Comparative and Experimental Medicine in the Intercollegiate section of this catalog.)

Because of the interdisciplinary departmental administration of the college, the faculty also have opportunities in the graduate programs of other instructional units, including Animal Science (nutrition, physiology, genetics and animal management), Microbiology (bacteriology, virology and immunology), Ecology and Evolutionary Biology (environmental toxicology), and Public Health. (Refer to other sections of this catalog for a full description of these programs.)

DOCTOR OF VETERINARY MEDICINE

Admission

To qualify for admission to the professional program of the College of Veterinary Medicine, a candidate must have completed at least the minimum pre-veterinary course requirements listed below. These may be completed at any accredited college or university that offers courses equivalent to those at the University of Tennessee, Knoxville. Pre-veterinary course requirements must be completed by the end of spring term of the year in which the applicant intends to enroll. Biochemistry requirements must have been satisfactorily completed within five years of the time the applicant wishes to enter the program.

<table>
<thead>
<tr>
<th>Subject Area</th>
<th>Semester Hours</th>
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</thead>
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<tr>
<td>English</td>
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<tr>
<td>Humanities and Social Sciences</td>
<td>18</td>
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<tr>
<td>Physics</td>
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<td>Biochemistry</td>
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<td>General Biology</td>
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<tr>
<td>Genetics</td>
<td>3</td>
</tr>
<tr>
<td>Cellular Biology</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>66</td>
</tr>
</tbody>
</table>

(1) If less than 18 semester hours of humanities and social sciences are completed, applicants must complete additional courses in these subject areas in order to meet the minimum pre-veterinary course requirements.

(2) For applicants who have completed 2 years of college or 45 semester hours, one semester of biology is required.

(3) For applicants who have completed 2 years of college or 45 semester hours, one semester of biology is required.

http://www.vet.utk.edu/
May include, for example, courses in English literature, speech, music, art, philosophy, religion, language, history, economics, anthropology, political science, psychology, sociology, and geography.

Exclusive of laboratory.

It is expected that this requirement will be fulfilled by a course in cellular or molecular biology.

Admission Procedures

Admission of new students is for the fall semester, with first priority given to residents of Tennessee.

The College of Veterinary Medicine utilizes the Veterinary Medical College Application Service (VMCAS) for all applicants. Instructions for making application for admission may be obtained from the Office of the Associate Dean, The University of Tennessee, College of Veterinary Medicine, 2407 River Drive, Room A102, Knoxville, Tennessee 37996-4550, or on-line at VMCAS(<www.aavmc.org>).

The deadline for receipt of the completed application materials is October 1. Non-Tennessee applicants must have a minimum cumulative grade point average of 3.20 on a 4.00 scale for applications to be considered.

Applications are accepted only from U.S. citizens or permanent residents of the U.S.

Requirements

The curriculum of the College of Veterinary Medicine is a nine-semester, four-year program. Each class begins in August and graduates four years later in May. The first three years generally follow the traditional fall and spring semesters with the summer break following years one and two. The final year of the professional curriculum begins immediately following semester six and is a continuous clinical rotation experience extending over 54 weeks.

Development of a strong basic science foundation is emphasized in the first year. Courses consist mostly of pre-clinical subjects of anatomy (gross and microscopic), physiology, immunology, bacteriology, virology, and parasitology. Also included in the first year are clinical subjects of physical diagnosis and epidemiology. Considerable integration of subject matter is incorporated during this year.

The second and third years include the study of diseases, their causes, diagnosis, treatment and prevention, and courses are team-taught on an organ system basis.

The final year (three semesters) is devoted to intensive education in solving animal disease problems involving extensive clinical experience in the Veterinary Teaching Hospital. Each student will participate exclusively in clinical rotations in the Veterinary Teaching Hospital and in required externships (preferably off-campus).

Innovative features of this curriculum include six weeks of student centered, small group, applied learning exercises in semesters one through five; three weeks of dedicated clinical experiences in the Veterinary Teaching Hospital in semesters three through five; and elective course opportunities in semesters four through nine which allow students to focus on individual educational/career goals. Students enrolled in the DVM program may register for up to 10 hours of graduate courses and these hours will be credited toward the DVM. Elective study offers a unique educational alternative for students in the College of Veterinary Medicine and is intended to enhance professional growth, concentration in an area of interest, and career opportunities.

In addition to education in the science and art of veterinary medicine, students receive instruction in paramedical subjects such as animal behavior, medical communication, professional ethics, jurisprudence, economics, and practice management.

The curriculum requires successful completion of 165 credit hours.

**VETERINARY PUBLIC HEALTH CONCENTRATION**

A veterinary public health concentration is available for students enrolled in the DVM curriculum and graduate veterinarians. This concentration is part of the Master of Public Health degree in the College of Education, Health, and Human Sciences. For more information, see Public Health in this catalog. The College of Veterinary Medicine shares governance of the concentration through the Public Health Academic Program Committee and student advisors within this concentration are faculty in the College of Veterinary Medicine. This concentration requires a separate application to the MPH Program.
AVIATION SYSTEMS
(UT Space Institute)
http://www.utsi.edu/Academic/AvSys/index.html
Stephen Corda, Chair and Graduate Program Director
Associate Professors
Corda, S. (Liaison), PhD  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Maryland
Solies, U.P., PhD  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Tennessee
Research Assistant Professor
Muratore, J., MS  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Houston
Ranaudo, R.J., MS  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Ohio
Emeritus Faculty
Collins, F.G., PhD  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . California

MAJOR DEGREE
Aviation Systems MS

The University of Tennessee Space Institute offers a program leading to the Master of Science degree with a major in aviation systems. Aviation systems is a unique blend of aerospace engineering, aviation technology, flight science, and flight test engineering and research. The aviation systems program is designed for those who possess a bachelor’s degree in engineering or science and wish to study under a system philosophy toward careers in research and development or administration in areas pertinent to aviation and aerospace. Current emphases include flight testing, aircraft performance and flying qualities, aircraft design, atmospheric and earth/ocean science, airborne sensing, and human factors.

Admission
To qualify for admission to this program, the applicant must possess a bachelor’s degree in engineering or science from an accredited institution, show evidence of ability to pursue and benefit from the program, and fulfill the University of Tennessee, Knoxville, graduate admission procedures and grade point standards. It is expected that the student will have completed coursework in calculus and physics, and preferably aerodynamics, aircraft performance, or other aerospace-related subjects.

MASTER OF SCIENCE
AVIATION SYSTEMS MAJOR

Both thesis and non-thesis programs are available. The thesis program requires a minimum of 30 hours credit while the non-thesis program requires a minimum of 33 hours. Both options are fully supported off-campus utilizing electronic media for recording and interactive distance teaching methods.

Requirements

Thesis Option
The thesis program involves satisfactory completion of the following requirements.

Research and Development Specialization
• 12 hours of 500-level courses in the major field of aviation systems.
• 6 hours in industrial engineering (engineering management).
• 6 hours of electives from the major field, mathematics or engineering.
• 6 hours of Aviation Systems 500 demonstrating the ability to conduct and report on an independent investigation.
• Defense of thesis and completion of final exam.

Administration Specialization
• 12 hours of 500-level courses in the major field of aviation systems.
• 3 hours in industrial engineering (engineering management).
• 3 hours in economics or finance.
• 6 hours of electives selected from the major field, mathematics or engineering.
• 6 hours of Aviation Systems 500 demonstrating the ability to conduct and report on an independent investigation.
• Defense of thesis and completion of final exam.
Non-Thesis Option

The non-thesis program will be permitted in special circumstances and involves satisfactory completion of the following requirements.

Research and Development Specialization

- 12 hours of 500-level courses in the major field of aviation systems.
- 6 hours in industrial engineering (engineering management).
- 12 hours of electives in the major field, mathematics, or engineering.
- 3 hours of an assigned project under Aviation Systems 550.
- A comprehensive final written examination on all coursework submitted for the degree and defense of the project course paper.

Administration Specialization

- 12 hours of 500-level courses in the major field of aviation systems.
- 3 hours in industrial engineering (engineering management).
- 3 hours in economics or finance.
- 12 hours of electives in the major field, mathematics, or engineering.
- 3 hours of an assigned project under Aviation Systems 550.
- A comprehensive final written examination on all coursework submitted for the degree and defense of the project course paper.

MAJOR DEGREES

Comparative and Experimental Medicine

http://www.vet.utk.edu/graduate

Robert N. Moore, Associate Dean and Graduate Program Director

Joint Graduate Coordinating Committee

Bartges, J.W., DVM, PhD, Small Animal Clinical Sciences
Lawler, J.E., PhD, Psychology
Matteson, K.J., PhD, Medical Genetics, Graduate School of Medicine
Moore, R.N., PhD, College of Veterinary Medicine

COMPARATIVE AND EXPERIMENTAL MEDICINE

MAJOR

Comparative and Experimental Medicine

DEGREES

MS, PhD

Comparative and Experimental Medicine (MS and PhD) is a jointly-administered graduate program intended to prepare students for teaching and/or research careers in the health sciences. This program emphasizes the comparative approach to the study of biomedical science. The PhD program is open to approved graduate students seeking training in this area and is especially useful for individuals with professional degrees. For the student with undergraduate biological science background, the comparative and experimental medicine program provides an unusual opportunity to study disease processes common in humans and animals from a multidisciplinary perspective. The scope of this intercollegiate program, which pools faculty resources from both veterinary and human medicine, is broadened by faculty members representing animal science and numerous areas of the life sciences. The interdisciplinary training environment includes such diverse support as facilities and personnel at the Veterinary Teaching Hospital, the University of Tennessee Medical Center at Knoxville, life sciences departments, College of Agricultural Sciences and Natural Resources, College of Engineering, and The Department of Nutrition.

For additional information, write to the Office of Research and Graduate Programs, or access the Web site.

MASTER OF SCIENCE

COMPARATIVE AND EXPERIMENTAL MEDICINE MAJOR

Admission

Admission requirements of the Graduate Council of the University of Tennessee, Knoxville, apply. In addition, all applicants must furnish three letters of recommendation from individuals who are familiar with their scholastic or professional records.

Applicants must have a baccalaureate degree with course work in chemistry through organic, mathematics through calculus, physics, and basic biology. More advanced study in biology such as biochemistry, mammalian anatomy, histology, cell biology, or other appropriate biomedical courses from an accredited university is recommended.

Applicants for admission to the Master of Science degree program whose backgrounds include no formal training in the biomedical field beyond the baccalaureate degree will be required to score at least 1,000 on the quantitative and verbal portions of the Graduate Record Examination.

Requirements

Students must complete a minimum of 24 hours of coursework and 6 hours of Thesis 500. Comparative and Experimental Medicine 504 and 541 are required, as are 4 hours of 600-level graduate journal clubs. In addition, students must take at least 3 hours of 500- or 600-level statistics and a minimum of 8 hours of coursework in a specified discipline. Areas of emphasis may include hematology, oncology, pathology, pharmacology, toxicology, immunology, genetics, infectious disease, epidemiology, metabolism, or other areas of medicine. Exceptions to accommodate students with specific interests must be approved by the Joint Graduate Coordinating Committee after application, in writing, to the director.

The graduate committee (at least three members) is chosen before the end of the second term and must include at least one member from the College of Veterinary Medicine and at least one member from the Graduate School of Medicine. If a minor is declared, one member must be from the minor discipline. A final oral examination must be passed at the completion of the program.

DOCTOR OF PHILOSOPHY

COMPARATIVE AND EXPERIMENTAL MEDICINE MAJOR

Admission

Admission requirements of the Graduate Council of the University of Tennessee, Knoxville, apply. In addition, all applicants must furnish three letters of recommendation from individuals who are familiar with their scholastic or professional records.

Applicants generally will be expected to have a professional degree in one of the medical sciences (e.g., MD, DDS, DVM) or a master’s degree in one of the biomedical sciences and a Graduate Record Examination score of at least 1000 for the quantitative and verbal sections.

An individual having a baccalaureate degree with a strong background in the physical and biological sciences may be admitted upon presenting evidence of exemplary performance on the Graduate Record Examination.

Exceptional veterinary students at the University of Tennessee, Knoxville, may be admitted to the comparative and experimental medicine graduate program but will be enrolled officially as veterinary students. During summers such students may take advantage of registering for graduate courses to be counted as elective courses in the veterinary program.
Requirements

Students with professional degrees (e.g., MD, DDS, DVM) or master’s degrees in a program-related biomedical science must complete at least 24 hours of coursework and 24 hours of Dissertation 600. Others must complete a minimum of 48 hours of coursework and 24 hours of Dissertation 600.

Comparative and Experimental Medicine 504 and 541 are required, as are 6 hours of 600-level graduate journal clubs. In addition, students must take at least 3 hours of 500- or 600-level statistics and a minimum of 8 hours of coursework in a specified discipline. Areas of emphasis may include hematology, oncology, pathology, pharmacology, toxicology, immunology, genetics, infectious disease, epidemiology, metabolism, or other areas of medicine. Exceptions to accommodate students with specific interests must be approved by the Joint Graduate Coordinating Committee after application, in writing, to the director. The doctoral committee is chosen during the first year. At least one member must be from the College of Veterinary Medicine and at least one member from the Graduate School of Medicine.

A comprehensive examination must be passed before the end of the third year of the program. In addition, students must prepare and defend a prospectus outlining their proposed research projects before the end of their third year in the program. Exceptions to these requirements are provided for medical residents pursuing doctoral degrees who must successfully complete the comprehensive examination and research prospectus before the end of their fourth year in the program.
Courses of Instruction

REGISTRATION NOTES
(RE) Prerequisite(s) and Corequisite(s) will be enforced by the Registration System in the future. They are currently enforced by the department.
(DE) Prerequisite(s) and Corequisite(s) are enforced by the department. Registration Restrictions are enforced by the Registration System.

Accounting (009)

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated.
Credit Restriction: May not be used toward degree requirements.

507 Financial Reporting Research and Contemporary Issues (3) Theory and practice of contemporary financial reporting issues are covered with an emphasis on researching the authoritative accounting literature. Specific contemporary issues covered vary each semester.
Comment(s): Master of Accountancy admission or consent of instructor required.

518 Professional Standards (3) Basic standards and contemporary issues relevant to assurance providers. Actual practice cases are used to illustrate application.
Comment(s): Master of Accountancy admission or consent of instructor required.

519 Seminar in Business Risk and Assurance Methodology (3) Business risk and emerging methodology used by assurance providers.
Comment(s): Admission to a graduate program or consent of instructor required.

521 Governmental, Not for Profit, and Management Accounting (3) Accounting principles and reporting models for governmental and not for profit organizations. Uses of management accounting information in decision making and performance evaluation.
Comment(s): Admission to a graduate program or consent of instructor required.

530 Tax Research, Accounting Practice, and Procedures (3) Methods of researching tax issues within the federal tax system with emphasis on Internet-based research tools. Tax accounting periods and methods. Tax procedures for dealing with the Internal Revenue Service. Tax practice standards and ethical concerns.
Comment(s): Master of Accountancy admission or consent of instructor required.

531 Tax Strategy and Entity Taxation (3) Introduction to tax research. Current issues in tax strategy and planning including investment models, implicit taxes, organizational form, and other selected topics. Income taxation of business entity operations including financial statement implications of income taxes.
Comment(s): Master of Accountancy admission or consent of instructor required.

532 Corporate Taxation and Reorganizations (3) Current issues in corporate taxation including organization and capital structure, distributions, liquidations, acquisitions, and reorganizations. Course emphasizes group projects and presentations. Web-based research tools used extensively.
(DE) Prerequisite or (DE) Corequisite: 531.
Comment(s): Master of Accountancy admission or consent of instructor required.

533 Taxation of Partnerships and S Corporations (3) Current issues in partnership and S corporation taxation including partnership formation, operations, allocations, and distributions; LLCs; S corporation election and operations; and comparisons of different flow-through entities. Course emphasizes group projects and presentations. Web-based research tools used extensively.
(DE) Prerequisite or (DE) Corequisite: 531.
Comment(s): Master of Accountancy admission or consent of instructor required.

539 Multi-Jurisdictional Tax Planning and Policy (3) International and state tax law as it pertains to business transactions. Particular emphasis is placed on identifying tax planning opportunities and designing tax strategies to meet planning objectives.
Comment(s): Master of Accountancy admission or consent of instructor required.

592 Graduate Internship in Accounting (3) Full-time resident professional employment for one academic semester involving qualified job experience, written report of responsibilities, and evaluation of student performance.
Comment(s): Master of Accountancy admission or consent of Master of Accountancy advisor required.

593 Individual Research in Accounting (3) Directed research in topic of mutual interest.
Repeatability: May be repeated. Maximum 6 hours.
Comment(s): Master of Accountancy admission or consent of Master of Accountancy advisor required.

600 Doctoral Research and Dissertation (3-15) Grading Restriction: PINP only.
Repeatability: May be repeated.
Registration Permission: Consent of PhD program advisor.

611 Doctoral Seminar in Accounting (3-15) Analysis of issues reflected in accounting literature.
Registration Permission: Consent of PhD program advisor.

621 Accounting Colloquium (1) Research and discussion of contemporary issues in practice of accounting.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated. Maximum 4 hours.
Registration Permission: Consent of PhD program advisor.

622 Accounting Colloquium (1) Research and discussion of contemporary issues in practice of accounting.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated. Maximum 4 hours.
Registration Permission: Consent of PhD program advisor.
Advertising (012)

490 Special Topics (3) Detailed study of a specialized area of advertising. Topics vary by semester and include advanced media strategy, advanced creative strategy, direct marketing, and multicultural advertising.

500 Thesis (1-15)
Grading Restriction: P/NP only.
Repeatable: May be repeated.
Comment(s): Admission to a degree program in Communication and Information required.

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when the student uses university facilities and/or faculty time before degree is completed.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatable: May be repeated.
Credit Restriction: May not be used toward degree requirements.

510 Advertising and Society (3) Analysis of advertising as institution in a free-enterprise democratic society and its relation to social, legal, cultural, and economic institutions.

520 Advertising and Communications Theory (3) Application of contemporary communications theories of attitude change, information-processing, and persuasion as applied to creative strategy decisions.
Comment(s): Admission to the program or consent of the instructor required.

530 Advertising and Public Relations Research (3) Nature, scope, and application of research function to advertising and public relations decisions.
(DE) Prerequisite(s): Statistics 531 or equivalent.

540 Advertising Decision Making (3) Analysis of decision making in budgeting, creative strategy, media strategy, research, evaluation, and agency-client relationships. Advertising response functions.
Comment(s): Admission to the program or consent of instructor required.

590 Project (3) Capstone project under guidance of faculty. Application of principles from previous coursework.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatable: May be repeated. Maximum 6 hours.
Comment(s): Admission to a degree program in Communication and Information required.

597 Independent Study (3)
Repeatable: May be repeated. Maximum 6 hours.
Registration Permission: Must be a graduate student. Advanced undergraduate students who wish to be considered must seek permission of instructor.

Aerospace Engineering (018)
Not all the courses listed below are available at both the University of Tennessee, Knoxville, and UTSI campuses.

422 Aerodynamics (3) Theory and design of aerodynamic bodies for desired characteristics. Potential flow theory, viscous effects, and compressibility effects. Subsonic, transonic, and supersonic airfoils.
(DE) Prerequisite(s): 351 and 370.

424 Astronautics (4) Solar system, orbital mechanics, propulsion, atmospheric entry including thermal protection materials, human factors in space flight, the space environment, and current topics.
(DE) Prerequisite(s): 351.
(DE) Corequisite(s): Mechanical Engineering 331.

(DE) Prerequisite(s): 351.

426 Introduction to Aerospace Design (2) Design process, synthesis, design studies, individual design reports required.
(DE) Prerequisite(s): 351, 370, and 363.
(DE) Corequisite(s): Mechanical Engineering 344.

429 Aerospace System Design (3) Synthesis and design of a complete aerospace system. Participation in team design effort including formal presentations and design report.
(DE) Prerequisite(s): 422, 425, and 426.

449 Aerospace Engineering Laboratory (3) Designing, conducting, and reporting results of experimental exercises. Test standards and specifications. Analysis of data and formation of conclusions.
(DE) Prerequisite(s): 345, 351, and 425.

494 Selected Topics in Aerospace Engineering (1-4) Problems and topics related to developments and practice in aerospace engineering.
Repeatable: Not repeatable. May be taken once for 1 – 4 hours.
Registration Permission: Consent of instructor.

495 Selected Topics in Aerospace Engineering (1-4) Problems and topics related to developments and practice in aerospace engineering.
Repeatable: Not repeatable. May be taken once for 1 – 4 hours.
Registration Permission: Consent of instructor.

500 Thesis (1-15)
Grading Restriction: P/NP only.
Repeatable: May be repeated.

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatable: May be repeated.
Credit Restriction: May not be used toward degree requirements.

509 Multidisciplinary Project (1) (See Industrial Engineering 509.)

511 Inviscid Flow (3) Kinematics and dynamics of inviscid fluids; potential flow about body; conformal mapping.
(DE) Prerequisite(s): 422 or 541, and Mathematics 425.

512 Viscous Flow (3) Derivation of fundamental equations of compressible viscous flow; boundary conditions for viscous heat-conducting flow; exact solutions for Newtonian viscous flow (Navier-Stokes) equations for special cases; similarity solutions. Thermal boundary layers, stability of laminar flows, transition to turbulence, 2-D turbulent boundary layer equations. Incompressible-turbulent mean flow, and compressible boundary layer flow.
Registration Permission: Consent of instructor.

513 Experimental Methods in Fluid Mechanics (3) Experimental techniques with laboratory experiments; representative experiments: hot wire anemometry and turbulence measurements, flow visualization, wind tunnel tests, water table experiments, supersonic flow experiments, boundary layer measurements, laser-optical measurements.
(DE) Prerequisite(s): 423 or 541.

515 Air Vehicle Aerodynamics and Performance (3) Application of aerodynamics principles to air vehicles to provide estimates of performance, stability, and control characteristics for subsonic to hypersonic speeds. Relations among thrust, drag, lift and attitude, propulsion systems, vehicle performance characteristics, and trajectory optimization.
(DE) Prerequisite(s): 422.

516 Air Vehicle Aerodynamics and Performance (3) Application of aerodynamics principles to air vehicles to provide estimates of performance, stability, and control characteristics for subsonic to hypersonic speeds. Relations among thrust, drag, lift, and attitude, propulsion systems, vehicle performance characteristics, and trajectory optimization.
(DE) Prerequisite(s): 515.

521 Aerodynamics of Compressible Fluids (3) One-dimensional internal and external flow; waves; small perturbation theory; slender body theory; similarity rules; method of characteristics.
(DE) Prerequisite(s): 422.

522 Aerodynamics of Compressible Fluids (3) One-dimensional internal and external flow; waves; small perturbation theory; slender body theory; similarity rules; method of characteristics.
(DE) Prerequisite(s): 521.

525 Hypersonic Flow (3) Slender body flow; similitude; Newtonian theory; blunt body flows; viscous interactions; free molecule and rarefied gas flow.
(DE) Prerequisite(s): 512.

527 Aerospace Ground Test Facilities (3) Atmospheric models and similarity considerations; aerodynamic test facilities: continuous and intermittent wind tunnels and ballistic ranges; propulsion test facilities or air breathing and rocket engines; space environment and space vehicle test facilities.
(DE) Prerequisite(s): 521, 541, and Mechanical Engineering 522.

531 Magnetohydrodynamics (3) Electromagnetic field theory; chemical kinetics; thermodynamic and thermophysical properties of gas plasmas; governing equations and applications.
(DE) Prerequisite(s): 422 and Mathematics 471.

532 Introduction to Turbulence (3) Macroscopic effects, analogies, statistical treatment, correlation functions, energy spectra, diffusion; application of turbulent jets and pipe flow.
(DE) Prerequisite(s): 511 and 512.

533 Dynamics (3) (See Mechanical Engineering 533.)
Aerospace vehicles, equations of motion, multibody problems and trajectory analysis.

(See Mechanical Engineering 541.)

542 Fluid Mechanics II (3) (See Mechanical Engineering 542.)

547 Modern Linear Controls (3) (See Mechanical Engineering 547.)

551 Aerospace Mechanics (3) Principles of mechanics applicable to aerospace vehicles, equations of motion, multibody problems and trajectory analysis.

(See Mechanical Engineering 542.)

554 Aerospace Vehicle Stability and Control (3) Static and dynamic longitudinal directional and lateral stability and control. Coupled modes. Motion with fixed and free flight control surfaces. Automatic control systems.

(See Mechanical Engineering 555.)

555 Human Vibrations Analysis and Protection (3) (See Biomedical Engineering 555.)


(See Mechanical Engineering 553.)

559 Advanced Mechanics of Materials I (3) (See Mechanical Engineering 559.)

711 Finite Elements for Engineering Applications (3) (See Engineering Science 551.)

720 Computational Fluid-Thermal Systems (3) (See Engineering Science 552.)

730 Computational Solid Mechanics (3) (See Engineering Science 553.)

590 Selected Engineering Problems (2-6)

Repeatability: May be repeated. Maximum 6 hours.

Comment(s): Enrollment limited to students in problems option.

592 Seminar (1) All phases of aerospace engineering, reports on current research at the University of Tennessee, Knoxville, and UTSI.

Grading Restriction: Satisfactory/No Credit grading only.

595 Seminar (1) All phases of aerospace engineering, reports on current research at the University of Tennessee, Knoxville, and UTSI.

Grading Restriction: Satisfactory/No Credit grading only.

599 Special Topics in Aerospace Engineering (1-3)

Repeatability: May be repeated. Maximum 6 hours.

600 Doctoral Research and Dissertation (3-15)

Grading Restriction: P/NP only.

642 Physical Gas Dynamics (3) High speed, high temperature gas flow from molecular point of view. Kinetic theory, statistical mechanics, equilibrium flow, vibrational and chemical rate processes, non-equilibrium vibrational and chemical flow, non-equilibrium kinetic theory, flow with translational non-equilibrium.

(See Mechanical Engineering 522.)

645 Theory of Turbulence (3) (See Engineering Science 645.)

647 Nonlinear Control Systems (3) (See Mechanical Engineering 647.)

659 Advanced Mechanics of Materials II (3) (See Mechanical Engineering 659.)

661 Advanced Topics in Computational Fluid Dynamics (3) (See Engineering Science 651.)

662 Advanced Topics in Computational Fluid Dynamics (3) (See Engineering Science 652.)


(See Mechanical Engineering 522.)

690 Advanced Topics in Aerospace Engineering (3)

Repeatability: May be repeated. Maximum 9 hours.

Registration Permission: Consent of instructor.

534 Atmospheric Entry (3) Reentry trajectories; lift and drag during reentry; vehicle motion and stability during reentry; aerodynamic heating and heat protection systems.

(DE) Prerequisite(s): 512.

Recommended Background: 522.

535 Mechanical Vibrations (3) (See Mechanical Engineering 534.)

539 Continuum Mechanics (3) (See Engineering Science 539.)

541 Fluid Mechanics I (3) (See Mechanical Engineering 541.)

542 Fluid Mechanics II (3) (See Mechanical Engineering 542.)

547 Modern Linear Controls (3) (See Mechanical Engineering 547.)

551 Aerospace Mechanics (3) Principles of mechanics applicable to aerospace vehicles, equations of motion, multibody problems and trajectory analysis.

(See Mechanical Engineering 542.)

554 Aerospace Vehicle Stability and Control (3) Static and dynamic longitudinal directional and lateral stability and control. Coupled modes. Motion with fixed and free flight control surfaces. Automatic control systems.

(See Mechanical Engineering 555.)

555 Human Vibrations Analysis and Protection (3) (See Biomedical Engineering 555.)


(See Mechanical Engineering 553.)

559 Advanced Mechanics of Materials I (3) (See Mechanical Engineering 559.)

711 Finite Elements for Engineering Applications (3) (See Engineering Science 551.)

720 Computational Fluid-Thermal Systems (3) (See Engineering Science 552.)

730 Computational Solid Mechanics (3) (See Engineering Science 553.)

590 Selected Engineering Problems (2-6)

Repeatability: May be repeated. Maximum 6 hours.

Comment(s): Enrollment limited to students in problems option.

592 Seminar (1) All phases of aerospace engineering, reports on current research at the University of Tennessee, Knoxville, and UTSI.

Grading Restriction: Satisfactory/No Credit grading only.

595 Seminar (1) All phases of aerospace engineering, reports on current research at the University of Tennessee, Knoxville, and UTSI.

Grading Restriction: Satisfactory/No Credit grading only.

599 Special Topics in Aerospace Engineering (1-3)

Repeatability: May be repeated. Maximum 6 hours.

600 Doctoral Research and Dissertation (3-15)

Grading Restriction: P/NP only.

642 Physical Gas Dynamics (3) High speed, high temperature gas flow from molecular point of view. Kinetic theory, statistical mechanics, equilibrium flow, vibrational and chemical rate processes, non-equilibrium vibrational and chemical flow, non-equilibrium kinetic theory, flow with translational non-equilibrium.

(See Mechanical Engineering 522.)

645 Theory of Turbulence (3) (See Engineering Science 645.)

647 Nonlinear Control Systems (3) (See Mechanical Engineering 647.)

659 Advanced Mechanics of Materials II (3) (See Mechanical Engineering 659.)

661 Advanced Topics in Computational Fluid Dynamics (3) (See Engineering Science 651.)

662 Advanced Topics in Computational Fluid Dynamics (3) (See Engineering Science 652.)


(See Mechanical Engineering 522.)

690 Advanced Topics in Aerospace Engineering (3)

Repeatability: May be repeated. Maximum 9 hours.

Registration Permission: Consent of instructor.

Africana Studies (023)

421 Comparative Studies in African and African-American Societies (3) Comparative studies of African and African-American societies in such areas as education, religion, and social stratification. Includes the respective views African-Americans and Africans have of each other and concept of Pan-Africanism.

433 Topics in Black Literature (3) (See English 443.)

450 Issues and Topics in African-American Studies (3) Topics vary but include a variety of problems, issues, and individuals from the field of African-American studies.

Repeatability: May be repeated. Maximum 6 hours.

452 Black African Politics (3) (See Political Science 452.)

461 Art of Southern and Eastern Africa (3) (See Art History 461.)

462 Art and Archaeology of Ancient Africa (3) (See Art History 462.)

463 Arts of the African Diaspora (3) (See Art History 463.)

470 African-American Art (3) (See Art History 470.)

473 Black Male in American Society (3) Examines historical images, myths and stereotypes which have developed concerning African-American males in American society. Includes the impact of such critical factors as black feminism, violence, concepts of masculinity, the family, white males, white females, homosexuality, nationalism, and athletics on African-American males in America.

484 African-American Women in American Society (3) Focuses on historical and contemporary social, economic, and political factors in American society as they relate to the black woman. (Same as Women's Studies 484.)

510 Special Topics (3)

Repeatability: May be repeated. Maximum 6 hours.

Agricultural and Extension Education (042)

440 Communication Techniques in Agriculture (3) Elements of effective use of mass media in agricultural and extension education. Effective technical writing and presentation strategies for agricultural audiences.

450 Agricultural Leadership Development (3) Identification of styles and roles of leadership; development of leadership techniques and skills required in working with organizations and youth groups; methods of resolving conflict, of communicating, of guiding and evaluating; and ethical considerations for leaders.

500 Thesis (1-15)

Grading Restriction: P/NP only.

501 Creative Component in Lieu of Thesis (3) Capstone experience completed under supervision of major professor and committee. Individual project: literature survey; development of teaching software; development of curriculum materials; development of white paper; or other suitable project.

Grading Restriction: Satisfactory/No Credit grading only.

Comment(s): Students in the non-thesis option only.

Registration Permission: Consent of major professor.

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed.

Grading Restriction: Satisfactory/No Credit grading only.

Credit Restriction: May not be used toward degree requirements.


(See Political Science 452.)

(See Extension History 450.)

521 Extension Program Planning and Evaluation (3) Theories and models of program development and evaluation and their use in extension education: planning and conducting needs assessments; planning, organizing, implementing and evaluating extension educational program content and learning activities; development and interaction of county, state and federal extension plans of work; and principles, techniques and instruments used to identify, gather and analyze information to evaluate extension programs.

(See Extension History 450.)
522 Educational Technology in Agricultural and Extension Educa-
tion (3) Advanced concepts and methods relevant to both formal and
non-formal instructional methodologies. Processes by which profession-
ally trained agents influence the introduction, adoption, and diffusion of
technological change.
(De) Prerequisite(s): 435 and 436 or consent of instructor.

524 Research Methodology (3) Social science research methods relat-
ed to research in agricultural and extension education. Issues: research
design, reliability and validity in measurement, sampling procedures,
logic of analysis, scaling and measurement, and selection and interpre-
tation of appropriate inferential tests of significance.
(De) Prerequisite(s): 436 and 511 or consent of instructor.

525 Curriculum Development in Agricultural and Extension Educa-
tion (3) Models, principles, and procedures for developing curricula in
agriculture and extension education programs and scheduling learning
activities used to implement these planned programs.
(De) Prerequisite(s): 435 and 436 or consent of instructor.

526 Agricultural Education for First-Year Teachers (2) Developing
competencies needed by first-year teachers for planning, organizing and
conducting program of vocational agriculture in local community. Group
meetings in selected centers and visits by instructor.
(De) Prerequisite(s): 436 and 436.

527 Adult Education Strategies in Agricultural and Extension Educa-
tion (3) Methods of developing and implementing educational programs for
adults in agricultural and extension education and related contexts: differ-
et learning of adults and children (androgy vs. pedagogy); understand-
ing and determining adult needs, priorities and motivation for participat-
ing in educational programs; adoption of new ideas by adult learners; methods
and materials effective in teaching adults; developing favorable attitudes
toward post-secondary education and life-long learning.
(De) Prerequisite(s): 211 and 511 or 346 or consent of instructor.

530 Special Topics in Agricultural and Extension Education (1-3)
Current issues.
Repeatability: May be repeated. Maximum 9 hours.
Registration Permission: Consent of instructor.

532 Managing Organizations, Programs and Personnel (3) Theory
and principles of management for individual and organizational effective-
ness of agricultural organizations.
(De) Prerequisite(s): 511 and 521 or consent of instructor.

592 Internship in Agricultural and Extension Education (1-3) Practi-
cal field experience in selected setting under supervision of local practi-
tioner and departmental representative.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated. Maximum 3 hours.
Registration Permission: Consent of instructor.

593 Special Problems in Agricultural and Extension Education (1-4)
Special research and/or special reports based on supervised independ-
ent study.
Repeatability: May be repeated. Maximum 6 hours.
Registration Permission: Consent of instructor.

Agricultural Economics (047)

412 Agricultural Finance (3) Macro-finance, financial objectives, acquisi-
tion of debt and equity funds, capital investments, capital allocation,
debt repayment, credit analysis, borrower and lender loan application
analysis, insurance strategies, computer applications, kinds and sources of
agricultural credit, and financial intermediation.

420 International Agricultural Trade and Marketing (3) Introduction to
real and monetary aspects of international trade effect on agricultural
commodity flows; partial equilibrium analysis of international trade in agri-
cultural products; institutional aspects of international marketing of agricul-
tural products.

430 Food and Agricultural Policy (3) Values, goals and policy process.
Economic rationale and effects of policy. Historical development and cur-
rent characteristics of commodity, credit, food, and trade policy.

442 Agribusiness Management (3) Advanced concepts in developing
business and marketing plans and in applied management principles
such as inventory control and pricing techniques. Discussion of manage-
ment issues including going international, employee supervision, man-
agement succession and guerilla marketing. Teamwork emphasized in
managing an agribusiness firm through game simulation. Written and
oral presentation required.

470 Natural Resource Economics (3) Economic analysis of natural re-
source use and conservation with emphasis on land, water and other re-
newable resources. Principles for benefit-cost analyses of natural re-
source projects and policies. Methods for valuation of non-market im-
pacts associated with natural resource use. Tools for analysis of spatially
referenced data.

500 Thesis (1-15)
Grading Restriction: P/NP only.
Repeatability: May be repeated.
Registration Restriction: Master of Science – agricultural economics major.

502 Registration for Use of Facilities (1-15) Required for the student
not otherwise registered during any semester when student uses univer-
sity facilities and/or faculty time before degree is completed.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated.
Credit Restriction: May not be used toward degree requirements.

503 Managerial Economics for Agribusiness (3) Practical application
of economic concepts to agribusiness management and marketing deci-
sions. Topics include supply and demand analysis, demand estimation,
production economics, cost analysis, pricing decisions, break-even
analysis, capital budgeting, time value of money, and risk and uncertain-
ty. Students will use Microsoft Excel to analyze managerial economic
questions.

505 Microeconomic Analysis (3) Theory of utility maximization and de-
mand, production, cost, firm behavior, and supply; price in product and
factor markets; efficiency and welfare.
Recommended Background: Calculus and intermediate microeconomics courses.

512 Advanced Agribusiness Finance (3) Financial and investment
analysis tools and concepts and their application to decisions faced by
agribusiness. Emphasis on financial analysis and planning principles,
capital budgeting, debt structure and financing, options, present value
concepts, and risk analysis.
Recommended Background: Senior-level finance course.

520 Research Methodology in Agricultural Economics (1) An overview
of the logic and process of economic inquiry. Topics covered in-
clude the relationship between theory and applied research, problem for-
mulation, definition of research problems, development of research prob-
lem statements with goals and objectives, and presentation and interpre-
tation of results.

524 Econometric Methods in Agricultural Economics (3) Application of
statistical methods to agricultural economic models; estimation of sup-
ply, demand and production functions; microeconomic forecasting mod-
els; interpretation of results.
Recommended Background: Calculus and statistics courses.

525 Agribusiness Operations Research Methods (3) Applications of
operations research methods and concepts for agribusiness. Theoretical
background and applied considerations of each technique with emphasis
on applications. Computer and other applications of each technique for
relevant agribusiness problems.
Recommended Background: Calculus and intermediate microeconomics courses.

530 Agricultural Policy Analysis (3) Evaluation of public policy as relat-
ed to agricultural industry and rural areas.

542 Advanced Agribusiness Production Decisions (3) Decision theo-
ry concepts and tools for analyzing agribusiness decision problems;
modeling choices using decision trees and sensitivity analysis; incorpo-
rating uncertainty into decision models using probability theory and sim-
ulation; modeling preferences using utility theory and risk attitudes.
(Re) Prerequisite(s): 505 or 503.

550 Advanced Agribusiness Marketing (3) Use of economic concepts in
agribusiness marketing decisions. Analysis of agricultural markets;
buyer behavior in food and fiber markets; competitive environment. Pro-
ficiency analysis of marketing and distribution decisions; market planning
and strategy; product evaluation and new product introduction; pricing
decisions.
(Re) Prerequisite(s): 505 or 503.

552 Advanced Agribusiness Seminar (3) A capstone course for stu-
dents in the Master of Science non-thesis agribusiness concentration.
The course centers on discussion and analysis of real-world manage-
ment case studies. Students are responsible for the development of a
comprehensive written case study analyzing a real-world agribusiness
management problem. Major writing and oral presentation emphasis.
Recommended Background: 2 completed semesters of the agricultural econom-
ics MS program.

570 Advanced Natural Resource Economics (3) Analysis of natural re-
source allocation issues; applied welfare economics, external effects and
evaluation of public policy.
509 Professional Internship (3) Supervised internship experience with appropriate agribusiness firm.
Contact Hour Distribution: 2 hours and 1 lab.
Grading Restriction: P/NP only.
Repeatability: May be repeated.
Recommended Background: Completion of 300-level core courses or consent of instructor.

707 Advanced Topics in Natural Resource Economics (3) Application of microeconomic theory to the use, allocation, and control of scarce, exhaustible, and renewable natural resources, including soil, water, minerals, forests, and fish, in both static and dynamic contexts. Optimal control theory, dynamic programming, supply of, and demand for, natural resources, social versus private decisions, market and non-market considerations, regulation, uncertainty, property rights, equity considerations, and landscape pattern and change.
Recommended Background: Advanced microeconomics course.

Agriculture and Natural Resources (088)

491 International Experience in Agriculture and Natural Resources (1-12) Credit for formalized international experiences related to agricultural sciences and natural resources. Determination of credit based on nature of the proposed experience. Student should discuss the opportunity with their faculty advisor prior to the trip to determine if it is appropriate for credit. Contact Hour Distribution: 2 hours and 1 lab.
Prerequisite(s): 320 or consent of instructor.
Recommended Background: 3 hours of statistics.

420 Advanced Reproduction (3) Collection, evaluation, and preservation of ova, spermatozoa and embryos; application of methods of natural breeding and techniques of artificial insemination and embryo transfer; herd sire and dam evaluation; pregnancy determination; gestation and parturition; infertility; recent advances in theriogenology.
Contact Hour Distribution: 1 hour and 2 labs.
Prerequisite(s): 320 or equivalent.

512 Teaching Internship in Agriculture and Natural Resources (1) Supervised experience in teaching — test preparation and evaluation of agriculture students.
Contact Hour Distribution: 1 hour and 2 labs.
Prerequisite(s): 320 or equivalent.

American Studies (099)

423 Geography of American Popular Culture (3) (See Geography 423.)

510 Special Topics (3) Repeatability: May be repeated. Maximum 6 hours.

Animal Science (113)

420 Advanced Reproduction (3) Collection, evaluation, and preservation of ova, spermatozoa and embryos; application of methods of natural breeding and techniques of artificial insemination and embryo transfer; herd sire and dam evaluation; pregnancy determination; gestation and parturition; infertility; recent advances in theriogenology.
Contact Hour Distribution: 1 hour and 2 labs.
Prerequisite(s): 320 or equivalent.

430 Nutrient Evaluation and Ration Formulation (3) Ration nutrient analysis and formulation for beef and dairy cattle, sheep, horses, swine, poultry, laboratory, zoo, and companion animals. Mathematical and computer solutions and applications to formulating complex rations with constraints.
Contact Hour Distribution: 2 hours and 1 lab.
Prerequisite(s): 330 or equivalent and an introductory computer science course.

481 Beef Cattle Production and Management (3) Integration of principles of nutrition, breeding, physiology, and marketing into complete production and management programs. Structure of industry, enterprise establishment, systems of production, production practices, and improvement programs. Management evaluated in terms of production response and economic returns. Comparisons made to small ruminant, forage-based production systems.
Contact Hour Distribution: 2 hours and 1 lab.
Recommended Background: Completion of animal science sophomore and junior core courses or consent of instructor.

482 Dairy Cattle Production and Management (3) Integration of principles of nutrition, breeding, physiology, and marketing into complete production and management programs. Structure of industry, enterprise establishment, systems of production, production practices, and herd improvement programs. Alternatives evaluated in terms of production responses and economic returns.
Contact Hour Distribution: 2 hours and 1 lab.
Recommended Background: Completion of 300-level courses or consent of instructor.
596 Seminar on Advanced Topics in Animal Science (1) Required of all first- and second-year MS students.

Repeatability: May be repeated. Maximum 2 hours.

600 Doctoral Research and Dissertation (3-15) P/NP only.

Grading Restriction: P/NP only.

Repeatability: May be repeated.

620 Topics in Microbial Pathogenesis (1-3) (See Microbiology 620.)

621 Advanced Topics in Animal Physiology (1-4) Recent advances and concepts, research techniques, current problems.

Repeatability: May be repeated. Maximum 6 hours.

623 Advanced Topics in Obesity (1-4) Recent advances and concepts, research techniques, and current problems of obesity related to nutrition and exercise sciences. Topics may include disease prevention and treatment, prevalence, etiology, metabolism, and molecular mechanisms of disease. (Same as Exercise Science 623.)

Repeatability: May be repeated. Maximum 6 hours.

631 Advanced Topics in Animal Nutrition (1-4) Recent advances and concepts, research techniques, current problems.

Repeatability: May be repeated. Maximum 6 hours.

652 Disorders of the Endocrine System (2) Pathological and physiological aspects of diseases; endocrine glands of various animal species. (Same as Comparative and Experimental Medicine – Veterinary Medicine 652.)

Recommended Background: 3 hours of physiology.

675 Statistical Genomics (3) Statistical concepts and methods for life sciences, including microarray, QTL, systems genetics and proteomics. Computer analysis of published data will guide the statistical discussion. Recommended Background: 6 hours of graduate level statistics. Familiarity with genomic experimental methodologies.

681 Advanced Topics in Animal Health and Well-Being (1-4) Recent advances and concepts, research techniques, and current problems associated with animal health and behavior.

Repeatability: May be repeated. Maximum 6 hours.

696 Seminar (1) Advanced topics in animal science. Required of all first- and second-year PhD students.

Repeatability: May be repeated. Maximum 2 hours.

Anthropology (122)

410 Principles of Cultural Anthropology (3) Exploration and illustration of major concepts, theories, and methods in cultural anthropology, with application to analysis of specific ethnographies.

(DE) Prerequisite(s): 130.

411 Linguistic Anthropology (3) Basic linguistic concepts applied to research in cultural anthropology, particularly investigation of relationships between language and culture. (Same as Linguistics 411.)

(DE) Prerequisite(s): 130 or Linguistics 200.

412 Folklore in Anthropology (3) Introduction to anthropological study of folklore, using folklore and folklore materials from various tribal, peasant, and complex societies.

(DE) Prerequisite(s): 130 or consent of instructor.

413 Dynamics of Culture (3) Definition and in-depth study of major forms of culture change, ranging from evolution and diffusion to religious revitalization and political revolt. Continuity and change in diverse cultural settings examined through use of archaeological, ethnohistoric, and contemporary cases.

(DE) Prerequisite(s): 130 or consent of instructor.

414 Political Anthropology (3) Examination of the organization and dynamics of power and politics in both stateless and state-level societies. Role of symbols, rituals, and ideologies in producing and reproducing power relations. The relationship between actors (individuals) and structures. The encapsulation of traditional political forms and systems within modern states.

(DE) Prerequisite(s): 130 or consent of instructor.

415 Environmental Anthropology (3) Overview of theoretical and methodological approaches to the study of human / environmental interactions. Impacts of environmental change on society and culture; human impacts on environmental change.

(DE) Prerequisite(s): 130.

Registration Permission: Consent of instructor.

416 Applied Anthropology (3) Introduction to principles, practice and ethics of anthropology applied to practical problems in non-academic settings. Overview of career opportunities in various domains of applied anthropology.

(DE) Prerequisite(s): 130 or consent of instructor.

431 Ethnographic Research (3) Conceptual and practical exploration of methods and techniques cultural anthropologists use in fieldwork.

(DE) Prerequisite(s): 130 or consent of instructor.

432 Anthropology of Warfare and Violence (3) Origins and tactics of warfare; overview of cultural foundations of warfare and structural violence; and effects on communities, social institutions, environments, and social organization.

(DE) Prerequisite(s): 130.

Registration Permission: Consent of instructor.

433 Historical Archaeology Laboratory (3) Laboratory procedures for processing, identification, and interpretation of artifacts from historical sites. Artifactual material from historic East Tennessee sites used for class projects.

Recommended Background: 361.

436 Cities and Sanctuaries of the Greek and Roman World (3) (See Classics 436.)

442 Intensive Survey of the Archaeology of the Prehistoric Aegean (3) (See Classics 442.)

443 Intensive Survey of the Archaeology of Greece (3) (See Classics 443.)

444 Intensive Survey of the Archaeology of Etruria and Rome (3) (See Classics 444.)

454 Archaeology of The African Diaspora (3) Historical archaeology of African, North American and Latin American sites relating to the transatlantic slave trade and the experiences of enslaved Africans in the New World from the 15th to the 19th centuries.

(DE) Prerequisite(s): 120 or 127.

Recommended Background: 361.

461 Archaeological Resource Management (3) Federal legislation and regulations affecting identification, protection, and management of archaeological resources. Professional ethics and responsibilities and relationship of federal and state agencies, public interest groups, and professional archaeologists in conduct of federally sponsored archaeology.

462 Early European Prehistory (3) Origins and evolution of human culture in Europe through beginnings of settled life. Primary focus on Paleolithic/Mesolithic chronology and lifeways.

(DE) Prerequisite(s): 120 or consent of instructor.

463 Rise of Complex Civilizations (3) Development of complex societies in old world from origins of agricultural economics to rise of states. Focus on Mesolithic, Neolithic, and Metal Age lifeways in Africa, Europe, and Asia.

(DE) Prerequisite(s): 120 or consent of instructor.

464 Principles of Zooarchaeology (3) Basic osteological studies of major vertebrate groups; with emphasis on the aboriginal's use of animals in subsistence and culture. Identification and interpretation of archaeologically derived molluscan and vertebrate remains; with introduction to laboratory use of comparative collections.

(DE) Prerequisite(s): 120 or consent of instructor.

465 Urban Archaeology (3) Field archaeology and interpretation of archaeological remains on historic urban sites in the United States. Course content will include lectures and field and laboratory research on urban sites in East Tennessee.

Recommended Background: 361.

466 Archaeology of Southeastern United States (3) Archaeological research on prehistoric American Indian cultures in Southeastern United States.

480 Human Osteology (4) Intensive examination of the human skeleton.

Contact Hour Distribution: 3 hours and 1 lab.

(DE) Prerequisite(s): 110 or consent of instructor.

481 Museum Studies I: Museums, Purpose and Function (3) (See Art 481.)

482 Museum Studies II: Exhibition Planning and Installation (3) (See Art 482.)

484 Museum Studies III: Field Projects (1-12) (See Art 484.)

485 Oral Biology (4) Intense examination of human dentition and oral skeletal structures; including dento-facial embryology/growth, histology, gross tooth morphology and pathology.

490 Primate Evolution (3) Living and fossil primate taxonomy, ecology, and comparative anatomy. Survey of primate fossil record with emphasis on the origin or major primate lineages.

(DE) Prerequisite(s): 110.

494 Primate Behavior (3) Social organization and behavior of selected primates: group composition, size, and structure; patterns of mating; other social interactions; communication; and cultural behavior. Application of primate studies to human ethology.

(DE) Prerequisite(s): 110 or consent of instructor.
500 Thesis (1-15)
Grading Restriction: P/NP grading only.
Repeatability: May be repeated.

501 Graduate Research (1-9)
Independent investigation of special problems in anthropology.
Repeatability: May be repeated. Maximum 18 hours.

502 Registration for Use of Facilities (1-15)
Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated.
Credit Restriction: May not be used toward degree requirements.

510 Method and Theory in Cultural Anthropology (3)
Development of primary theoretical orientations by cultural anthropologists; formulation of research problems and methods of collecting, organizing, and utilizing data.
Registration Permission: Consent of instructor.

511 Special Topics in Cultural Anthropology (3)
Seminars for advanced students on topics of special interest: ethnomedicine, psychological anthropology, comparative social organization, religion, and art.
Repeatability: May be repeated. Maximum 9 hours.
Registration Permission: Consent of instructor.

512 Urban Studies in Anthropology (3)
Process of urbanization examined cross-culturally; theory and method in researching urban communities; urban problems and applied anthropology.

515 Medical Anthropology (3)
Cultural impact on disease patterning theories of disease causation, and models of therapy. Theoretical and applied aspects of the anthropological study of health and disease.
Registration Permission: Consent of instructor.

517 Forms of Social Inequality (3)
Anthropological perspectives on societies stratified along lines of rank, caste, race, ethnicity, and class; inequalities engendered by sex role structure. Construction of social distinctions before and after rise and consolidation of modern world system. Intersections of race and ethnicity with class and gender.

520 Seminar in Zooarchaeology (3)
Approaches to analysis and interpretation of archaeological fauna. Intensive reading; evaluation and discussion of major faunal studies, guides to identification, methods of presenting faunal data.
Repeatability: May be repeated. Maximum 6 hours.

521 Laboratory Studies in Zooarchaeology (4)
Examination and comparison of skeletons of major vertebrae groups, shells of terrestrial and aquatic mollusks, in relation to animal remains from archaeological contexts. Basic osteology and shell characters of species encountered in archaeological sites; use of comparative collections.
Repeatability: May be repeated. Maximum 8 hours.

522 Seminar in Archaeology (3)
Theoretical and practical issues in contemporary archaeology: ethnarchaeology, paleoethnobotany, taphonomy, ceramic analysis, agricultural origins, and regional archaeological cultures.
Repeatability: May be repeated. Maximum 9 hours.

530 Fieldwork in Archaeology (3-9)
Practicum in surveying, excavating, processing, and analysis of archaeological data.
Repeatability: May be repeated. Maximum 9 hours.
Registration Permission: Consent of instructor.

550 Contemporary Issues in Anthropology (1-3)
Review of recent directions in method and theory in anthropology.
Repeatability: May be repeated. Maximum 6 hours.

560 Theory in Archaeology (3)
Detailed consideration of theory in contemporary archaeology: models of scientific explanation, research design, archaeological formation processes, and methods of analysis and interpretation.

562 Special Topics in Mediterranean Archaeology (3)
(See Classics 562.)

563 Lithic Artifac Analysis (3)
Methods for analyzing prehistoric stone tools in practical laboratory/lecture format. Stone tool production, use, stylistic variability, and discard processes.

565 Graduate Seminar in Ancient Mediterranean Civilization (3)
(See Classics 565.)

580 Advanced Human Variation (3)
Genetic and morphological variation among extant human groups; relationships of variation to geography, ecology and subsistence.

581 Forensic Anthropology (3)
(De) Prerequisite(s): 480.

582 Paleanthropology (4)
Fossil record from origin of hominids to appearance of anatomically modern humans. Functional morphology and phylogenetic relationships of fossil humans.
(De) Prerequisite(s): 480.

583 Skeletal Biology (3)
Practical and theoretical approaches to analysis of prehistoric human skeletal remains. Demography, vital statistics, pathology, nutrition, and measures of biological relationships as related to population as adaptive unit.
(De) Prerequisite(s): 480.

585 Laboratory Studies in Biological Anthropology (3)
Topical coverage of laboratory methods in biological anthropology.
Repeatability: May be repeated. Maximum 9 hours.
Registration Permission: Consent of instructor.

590 Method and Theory in Biological Anthropology (3)
Current methods of analysis in biological anthropology and of past and current history of theoretical perspectives. Paleoanthropology, human osteology, and human variation and population structure.
Registration Permission: Consent of instructor.

591 Foreign Study (1-15)
Repeatability: May be repeated. Maximum 15 hours.

592 Off-Campus Study (1-15)
Repeatability: May be repeated. Maximum 15 hours.

593 Independent Study (1-15)
Repeatability: May be repeated. Maximum 15 hours.

600 Doctoral Research and Dissertation (3-15)
Grading Restriction: P/NP only.
Repeatability: May be repeated.

601 Advanced Graduate Research (1-6)
Independent investigation of special problems in anthropology by advanced graduate students.
Repeatability: May be repeated. Maximum 12 hours.
Credit Restriction: Only 3 hours may be applied toward the 600-level requirement.

611 Advanced Seminar in Cultural Anthropology (3)
Critical evaluation of current issues in theory and data interpretation.
Repeatability: May be repeated. Maximum 6 hours.

660 Advanced Seminar in Archaeology (3)
Selected topics in prehistoric and historic archaeology.
Repeatability: May be repeated. Maximum 6 hours.

690 Selected Topics in Physical Anthropology (3)
Repeatability: May be repeated. Maximum 6 hours.
Comment(s): For doctoral students in biological anthropology concentration.

691 Selected Topics in Paleoanthropology (3)
Repeatability: May be repeated. Maximum 6 hours.

695 Gross Human Anatomy (9)
Skeleten, muscles, and cardiovascular system. Dissection of cadavers.
Contact Hour Distribution: 5 hours and 5 labs.
(De) Prerequisite(s): 480 or human biology course.

Architecture (133)

403 Introduction to Preservation (3)
History, theory, and legal aspects of architectural preservation and restoration.

404 Preservation Technology (3)
Techniques of preservation. Methods of analysis, history of materials and technology used in old buildings.
(De) Prerequisite(s): 403.

406 Ideas in Architecture (3)
Historical and critical review of major ideas of architecture through the ages.
Comment(s): Open to all students.

410 History and Theory of Urban Form (3)
Patterns of community development. Selected historical and contemporary examples. Basic urban design issues and exemplary design approaches examined through lectures, readings, essays, and sketch studies including historical change in urban form and design.

412 Non-Western and Indigenous Architecture (3)
Building responsive to climate, material availability, and economic level, as designed by anonymous builders. Examples from prehistoric times to present including the fertile crescent; the Indus Valley; Hindu, Buddhist, and Mughal architecture of India, China, and Japan.

417 The International Style (3)
Survey of architecture of the early modern movement, primarily in Europe and America, covering the years 1900 to 1940.

420 History of American Architecture (3)
Consideration of architecture and city planning in the United States from the pre-Columbian period until the mid-20th-century.
425 Special Topics in Architecture (1-6) Faculty-initiated courses. Topics vary.
Repeatability: May be repeated. Maximum 12 hours.
Registration Permission: Consent of instructor.

433 Computer Applications in Design III (3) Advanced course that integrates three-dimensional modeling and technical analysis with computers to augment building design. Independent studies under faculty direction.
Registration Permission: Consent of instructor.

463 Architectural Development (3) Principles and practice of the architect as a developer. Impact of economics, finance and urban policy on the design and development of real estate.
Comment(s): Open to all students.

473 Architectural Photography (3) Photography as a design, research, and presentation medium. Application of photographic techniques, printing and processing. Color, black and white.

500 Thesis (1-15)
Grading Restriction: Pass/No Credit grading only.
Repeatable: May be repeated.

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatable: May be repeated.
Credit Restriction: May not be used toward degree requirements.

503 Modern Architecture: Histories and Theories (3) History and theory of modern architecture: late 19th and 20th centuries through broad-based examinations of the history of modernity and specific case studies of buildings, projects, landscapes and theories.

507 Architecture, Culture and Modernity (3) Scope of ideas generated in architecture's recent history to reveal and explain production and reception of architecture: historical background necessary to understand those concepts. Complements history sequence but in specialized field of theory.

509 Seminar in Architectural Technology (3) Technological aspects influencing building form. Role of technical aspects of structural, environmental and building infrastructure in integrated systems supporting access and expression of building.

514 Seminar in Ethical Imperatives (3) Social, cultural, philosophical and moral issues which impact professional responsibilities. Attitudes, values, and ideas that address formation of professional's ethos.

515 Seminar in Issues in Urban Design (3) Investigations of urban forms, patterns, and attitudes that have shaped towns and cities.
Registration Permission: Consent of instructor.

516 Materials and Methods of Construction (3) Properties of interior and exterior building materials and their relation to construction methods and detailing. Theory of materials selection and application and role materials and methods play in design process.

521 Principles of Architectural Form (3) Historical and contemporary architectural theory through investigation of literature and related examples. Theories of understanding and theories of application related to generation of architectural form and space in response to both cultural and environmental focus.
Registration Restriction(s): Master of Architecture – architecture major.

525 Special Topics in Architecture (1-3) Student- or instructor-initiated course.
Grading Restriction: Satisfactory/No Credit or letter grade. Repeatable: May be repeated. Maximum 9 hours.

526 Directed Readings in Architecture (3) Readings on topics of interest: primary texts, history, theory, urban issues, technology and professional practice.
Repeatable: May be repeated. Maximum 9 hours.
Registration Permission: Consent of instructor.

528 Topics in Architectural History and Theory (3) Historic topics, ideas, and theories in architecture.
Registration Permission: Consent of instructor.

535 Presentation Design I (3) Basic techniques and understanding of graphic presentation design within the profession of architecture. Addresses fundamental design principles, page layout, image manipulation and typography, employing computer software applications. Conducted through lectures, assigned projects, assigned readings, labs, exams and/or critiques.
(DE) Prerequisite: 231.
Registration Permission: Consent of instructor.

536 Presentation Design II (3) Advanced techniques and understanding of graphic presentation design within the profession of architecture. Addresses document design, layout and binding, image manipulation and typography, employing computer software applications. Conducted through lectures, assigned projects, assigned readings, labs, exams and/or critiques.
(DE) Prerequisite(s): 535.
Registration Permission: Consent of instructor.

545 Principles of Environmental Control I (3) Introduction to heating, ventilating, air conditioning, solar energy, plumbing, and fire-protection systems.
(DE) Prerequisite(s): 180.
Comment(s): Enrollment is limited to Master of Architecture students.

551 Research Methods (3) Quantitative and qualitative methods of researching in architectural inquiry. Systematic study and application of applied and speculative investigations in field of architectural research. Review and identification of techniques and methodologies and applications for architectural research and scholarship.

553 Advanced Topics in Architectural Technology (3) In-depth investigations and analysis: architectural technology lighting, structure, enclosure, mechanical and other architectural technologies.
Registration Permission: Consent of instructor.

562 Professional Practice (3) Management and organizational theories and practices for delivering professional design services: assessment of building industry and its influence on practice; analysis of basic management functions within professional firms; legal and ethical concerns facing practitioners today; and introduction to special obligations and privileges of design professional.

571 Architectural Design Studio: Building Groups/Complexes (6) In-depth investigations analyzing cultural and contextual influences and precedents informing architectural form, space and structure in communal complex of buildings. Design of residential, recreational, educational, religious and communal facilities comprising distinctive/individual and modular/repetitive units.
(DE) Prerequisite(s): 282.

572 Architectural Design Studio: Technological Traditions (6) In-depth investigations analyzing tectonic influences and traditions in forming architectural form, space and structure. Design of building: coordination of material assembly, environmental control, structure, acoustics and lighting.
(DE) Prerequisite(s): 571.

(D) Prerequisite(s): 572.

(DE) Prerequisite(s): 551.

589 Urban Site Planning Workshop (4) Explores ideas, vocabulary, conventions, and technical skills essential to a critical understanding of how design and planning operate within the various scales of urban and ecological context. Examines both underlying terrain elements (landform, vegetation, water, climate) and human site interventions (urban infrastructure, buildings, and landscape). Strategies and analysis techniques for reading, mapping, and analyzing urban sites are introduced, as are issues, language, and principles of site design in urbanized landscapes.
Comment(s): Open to all majors.
Registration Permission: Consent of instructor.

591 Foreign Study (1-9)
Repeatable: May be repeated. Maximum 12 hours.
Registration Permission(s): Consent of instructor and approval of graduate program in architecture.

592 Off-Campus Study (1-9)
Repeatable: May be repeated. Maximum 12 hours.
Registration Permission(s): Consent of instructor and approval of graduate program in architecture.

593 Independent Study (1-9)
Repeatable: May be repeated. Maximum 15 hours.
Registration Permission(s): Consent of instructor and approval of graduate program in architecture.
Art (140)

481 Museum Studies I: Museums, Purpose and Function (3) Purposes, functions, and development of museums of art, history, natural and applied science. (Same as Anthropology 481.)

482 Museum Studies II: Exhibition, Planning and Installation (3) Exhibition concept development and implementation. Exhibition design and installation techniques. Publicity, production, mounting and framing, shipping and storage. (Same as Anthropology 482.)

(De) Prerequisite(s): 481 or consent of instructor.

484 Museum Studies III: Field Projects (1-12) Special field projects including restoration, preservation, registration, and other related research on or off campus. (Same as Anthropology 484.)

Repeatability: May be repeated. Maximum 12 hours.

(De) Prerequisite(s): 481 and 482.

Registration Permission: Consent of instructor.

499 Special Topics (3) Student- or instructor-initiated course offered at convenience of department.

Repeatability: May be repeated. Maximum 12 hours.

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed.

Grading Restriction: Satisfactory/No Credit grading only.

Repeatability: May be repeated.

Credit Restriction: May not be used toward degree requirements.

503 Theory and Practice of Art Fundamentals (1) Required for all GTA's. Surveys art theory and practice as it relates to teaching art foundations. Practical instruction, professional development, and pedagogy will be introduced in the form of lectures, group discussions, readings and project development.

507 Professional Practices: Teaching Internship (1) Individual study in development of skills and methodology in teaching studio courses.

Grading Restriction: Satisfactory/No Credit grading only.

Repeatability: May be repeated. Maximum 4 hours.

Credit Restriction(s): May not be applied toward degree requirements.

Comment(s): Enrollment is limited to students who are not GTAs.

Registration Permission: Consent of instructor.

591 Foreign Study (1-6)

Repeatability: May be repeated. Maximum 15 hours.

592 Off-Campus Study (1-6)

Repeatability: May be repeated. Maximum 15 hours.

593 Independent Study (1-4)

Repeatability: May be repeated. Maximum 15 hours.

Registration Permission: Consent of instructor.

595 Visiting Artist Seminar (2) Contemporary art issues by different visiting artists.

Repeatability: May be repeated. Maximum 8 hours.

Credit Restriction: May not be applied toward the art history requirement.

Art Ceramics (135)

421 Ceramics: Advanced Handbuilding (6) Continued investigation of ceramic form with an emphasis on the development of individual direction.

Repeatability: May be repeated. Maximum 18 hours.

(De) Prerequisite(s): 321 and 322.

422 Ceramics: Advanced Throwing (6) Continued, in-depth investigation of ceramic form: emphasis on the development of individual direction.

Repeatability: May be repeated. Maximum 18 hours.

(De) Prerequisite(s): 321 and 322.

424 Ceramics: Clays and Glazes (3) Clay chemistry, clay bodies, glaze theory, and calculation. Formulating, mixing and testing of clay bodies and glaze formulas.

(De) Prerequisite(s): 320.

429 Ceramics: Special Topics (3) Student- or instructor-initiated courses to be offered at convenience of department.

Repeatability: May be repeated. Maximum 12 hours.

Registration Permission: Consent of instructor.

521 Graduate Ceramics I (2-5)

Repeatability: May be repeated. Maximum 10 hours.

525 Graduate Ceramics II (2-5)

Repeatability: May be repeated. Maximum 10 hours.

593 Independent Study (1-4)

Repeatability: May be repeated. Maximum 15 hours.

Registration Permission: Consent of instructor.

595 Visiting Artist Seminar (2) Contemporary art issues by different visiting artists.

Repeatability: May be repeated. Maximum 8 hours.

Credit Restriction: May not be applied toward the art history requirement.

599 Projects in Lieu of Thesis (10)

Grading Restriction: Satisfactory/No Credit grading only.

Repeatability: May be repeated. Maximum 20 hours.

Comment(s): Completion of all graduate coursework and successful second-year evaluation by graduate faculty required.

Art Design/Graphic (136)

400 Typography (3) Principles of typography as well as classical and contemporary type forms, as vehicles for communication. An intensive introduction to the fundamentals of type, from individual letterforms to large bodies of textual information. Attention to formal, technological, rhetorical and historical issues.

(De) Prerequisite(s): Art 295 and Art Design/Graphic 251.

405 Computer Enhanced Graphic Design (3) Exploration of new technologies and their significance to graphic design.

Repeatability: May be repeated. Maximum 12 hours.

(De) Prerequisite(s): 351 and 356 with a grade of C or better.

Registration Permission: Consent of instructor.

410 Advanced Typographic Investigation (3) Expands on principles introduced in Typography (Art Design/Graphic 400). Projects will include work in reflective as well as electronic environments with an emphasis on personal exploration.

(De) Prerequisite(s): Art Design/Graphic 400.

425 Illustration (3) Develops skills and critical analysis for effective visual communication. Projects will explore the relationship between image and meaning. Students will explore a variety of media as they develop a personal visual vocabulary.

Repeatability: May be repeated. Maximum 12 hours.

(De) Prerequisite(s): Art 295 and Art Design/Graphic 251.

451 Advanced Graphic Design (3) Theory and techniques of visual problem-solving as applied to advanced applications of graphic design.

(De) Prerequisite(s): 352 with a grade of C or better.

452 Graphic Design Seminar (3) Theory and techniques of visual design. Projects culminate in a student-initiated project.

(De) Prerequisite(s): 451 with a grade of C or better.

456 Graphic Design Practicum (1-12) Practical work experience in the graphic design field. Must be prearranged with department.

Repeatability: May be repeated. Maximum 20 hours.

Registration Permission: Consent of instructor.

459 Special Topics in Graphic Design (3) Student- or instructor-initiated course offered at convenience of department.

Repeatability: May be repeated. Maximum 12 hours.

Registration Permission: Consent of instructor.

550 Studies in Graphic Design/Illustration History (3) Design and illustration c. 1850 to present.

Repeatability: May be repeated. Maximum 6 hours.

Comment(s): Enrollment is limited to MFA candidates.

551 Graphic Design I (2-6)

Repeatability: May be repeated. Maximum 10 hours.

552 Graphic Design II (2-6)

Repeatability: May be repeated. Maximum 10 hours.

593 Independent Study (1-4)

Repeatability: May be repeated. Maximum 15 hours.

Registration Permission: Consent of instructor.

595 Visiting Artist Seminar (2) Contemporary art issues by different visiting artists.

Repeatability: May be repeated. Maximum 8 hours.

Credit Restriction: May not be applied toward the art history requirement.

599 Projects in Lieu of Thesis (10)

Grading Restriction: Satisfactory/No Credit grading only.

Repeatability: May be repeated. Maximum 20 hours.

Comment(s): Completion of all graduate coursework and successful second-year evaluation by graduate faculty required.
Art Drawing (137)
419 Special Topics in Drawing and Painting (3) Student- or instructor-initiated course offered at convenience of department to enhance and expand the painting, drawing, and watercolor curriculum.
   Repeatability: May be repeated. Maximum 12 hours.
   Registration Permission: Consent of instructor.
511 Graduate Drawing I (2-6)
   Repeatability: May be repeated. Maximum 10 hours.
512 Graduate Drawing II (2-6)
   Repeatability: May be repeated. Maximum 10 hours.
593 Independent Study (1-4)
   Repeatability: May be repeated. Maximum 15 hours.
   Registration Permission: Consent of instructor.
595 Visiting Artist Seminar (2) Contemporary art issues by different visiting artists.
   Repeatability: May be repeated. Maximum 8 hours.
   Credit Restriction: May not be applied toward the art history requirement.
599 Projects in Lieu of Thesis (10)
   Grading Restriction: Satisfactory/No Credit grading only.
   Repeatability: May be repeated. Maximum 20 hours.
   Comment(s): Completion of all graduate coursework and successful second-year evaluation by graduate faculty required.

Art History (139)
403 History of Photography (3) Survey of history of photography from introduction of daguerreotype and calotype to more recent trends. Emphasis will be placed on aesthetics and the use of photography as a medium for artistic expression.
411 Art of South and Southeast Asia (3) Survey of art and architecture of the Indian subcontinent and Southeast Asia from 2000 BC to the 20th-century. The major achievements of each period are examined in relation to their religious, political, and social contexts.
415 Art of China (3) Survey of art and architecture of China from the Neolithic period to the 20th-century. The major achievements of each period are examined in relation to their religious, political, and social contexts.
416 Chinese Art of the 20th- and 21st-Centuries (3) Survey of Chinese art from the late 19th-century through the present. Hong Kong, Taiwanese, and expatriate artists are also considered.
419 Art of Japan (3) Survey of the art and architecture of Japan from the Neolithic period to the 20th-century. The major achievements of each period are examined in relation to their religious, political, and social contexts.
425 Early Christian and Byzantine Art to 1350 (3) Art in Italy and the Eastern Empire from the beginnings of Christian art to c. 1350. Mosaic and painting, sculpture and architecture. (Same as Judaic Studies 425.)
431 Medieval Art of the West, 800-1400 (3) Western European art of the Dark Ages, Romanesque, and Gothic periods. (Same as Judaic Studies 431; Medieval Studies 431.)
441 Northern European Painting, 1350-1600 (3) From courtly art of late Middle Ages to Northern Renaissance. Jan van Eyck, Roger van der Weyden, and Dürer; early printmakers. (Same as Medieval Studies 441.)
442 Art of Northern Europe, 1600-1675 (3) Concentrated study of Bruegel, Rubens, Rembrandt, Georges de La Tour, Vermeer, Poussin, and Hals.
451 Art of Italy, 1250-1450 (3) Development of exploration of naturalism. Revival of antiquity and development of theories of perspective in the Early Renaissance. Including Duccio, Giotto, Masaccio, Donatello, Botticelli. (Same as Medieval Studies 451.)
453 Art of Southern Europe, 1575-1700 (3) Concentrated study of Caravaggio, Bernini, and Italian Baroque developments in all media. Spanish Baroque painting and sculpture with special attention to Velazquez.
454 Renaissance and Baroque Theory (3) Addresses the theory of Western art in the early modern period with emphasis on the development and evolution in European Art during the Renaissance and Baroque periods. (DE) Prerequisite(s): 172 and 173 or consent of instructor.
461 Art of Southern and Eastern Africa (3) Art traditions of the eastern and southern regions of Africa. Sculpture, painting, pottery, textiles, architecture and human adornment will be examined. Some ancient Stone and Iron Age traditions will be examined, but the main emphasis will be on the diverse ethnic and regional art traditions practiced in the area from 19th-century to present. (Same as Africana Studies 461.)
462 Art and Archaeology of Ancient Africa (3) Historical art traditions of sub-Saharan Africa. Topics to be covered include prehistoric rock paintings; art from archaeological sites and ancient kingdoms. The time period covered ranges from the first and second millennia BC for some of the early terracotta sculpture and rock paintings, the 11th through 19th centuries AD for the later ancient kingdoms. (Same as Africana Studies 462.)
463 Arts of the African Diaspora (3) Examines the aesthetic, philosophical and religious patterns of the African descendants of Brazil, Surinam, the Caribbean and the United States. Emphasis will be placed on the full range of art forms, including the sculptural and performance traditions, as well as architecture, textile, basketry and pottery art forms. (Same as Africana Studies 463.)
464 Oceanic Art (3) Concentrated study of selected sculpture, textiles, architecture and other traditional art forms of Polynesia, Micronesia, and Melanesia. Objects are discussed on the basis of style, style relationship, iconography and the uses to which they were put in their traditional religious, political and social contexts.
470 African-American Art (3) Traces the artistic and social legacy of African-American art from the eighteenth-century to the present day. Specifically, this class will focus on the ways in which artists used creativity to confront, deny, or complicate understandings of racial identity and racism. Examines broad scope of artistic production including painting, sculpture, photography, multi-media, fiction writing, and video art. (Same as Africana Studies 470.)
472 History of 20th-Century American Art (3) Developments in architecture, painting, and design from 1900.
473 19th-Century American Art (3) Examines painting, sculpture, and print culture from the Revolutionary War to the turn of the 20th-century.
474 Theory of 20th-Century Art in Europe and America (3) Addresses the theoretical basis for the modern movement. Emphasis on analyzing and discussing individual works of art in light of contemporary writings by artists and theorists. (DE) Prerequisite(s): 172 and 173 or consent of instructor.
476 History of 20th-Century Painting and Sculpture in Europe (3) Development of the Modern and Post-Modern movements in Europe. Investigation of progression of abstraction through more recent conceptual trends. Analysis of the work of individual artists such as Picasso, Matisse, and many others.
479 Special Topics in Art History (3) Student- or instructor-initiated course offered at convenience of department.
   Repeatability: May be repeated. Maximum 12 hours.
480 Studies in Art History (3) Concentration in individually selected area.
   Repeatability: May be repeated. Maximum 6 hours.
   Registration Permission: Consent of instructor.
510 History and Philosophy of Art Education (3) United States from 1860s to present.
   Registration Permission: Consent of instructor.
520 Studies in Art Education (3) Issues and topics current to the field of art education.
   Registration Permission: Consent of instructor.
530 Production and Critical Pedagogy in Art (3) Relationship of production to aesthetics and critical analysis of works of art.
540 Use and Construction of Instructional Materials for Teaching Art (3) Examination and construction of curriculum and instructional aids related to teaching strategies in art education.
571 Studies in Medieval Art (3) Concentrated study of the major monuments from Byzantium or western Europe.
   Repeatability: May be repeated with consent of department. Maximum 6 hours.
   Registration Permission: Consent of instructor.
572 Studies in Italian Renaissance Art (3) Art and architecture of the 14th, 15th, and/or 16th centuries in Italy. Early or High Renaissance or Mannerist periods.
   Repeatability: May be repeated with consent of department. Maximum 6 hours.
   Comment(s): For MFA candidates.
573 Studies in Baroque Art (3) Seventeenth-century art and architecture – major artists and works from southern or northern Europe.
Repeatability: May be repeated with consent of department. Maximum 6 hours.
Comment(s): For MFA candidates.

574 Studies in Modern Western Art (3) Selected topics in 19th- and 20th-century western art.
Repeatability: May be repeated with consent of department. Maximum 6 hours.
Comment(s): For MFA candidates.

575 Studies in Modern American Art (3) Selected topics in 19th- and 20th-century American art.
Repeatability: May be repeated with consent of department. Maximum 6 hours.
Comment(s): For MFA candidates.

576 Studies in Asian Art (3) Selected topics in Japanese or Chinese Art.
Repeatability: May be repeated with consent of department. Maximum 6 hours.
Comment(s): For MFA candidates.

579 Special Topics in Art History (3) Student- or instructor-initiated course offered at convenience of department.
Repeatability: May be repeated with consent of department. Maximum 9 hours.
Comment(s): For MFA candidates.

Art Media Arts (134)

431 Photography III (3-6) Individual development of photographic problems and techniques.
Repeatability: May be repeated. Maximum 12 hours.
(DE) Prerequisite(s): 231, 330, and 331.

433 History of Film and Modern Art (3) Study of the development and interaction between cinematic arts and visual arts within the context of modern art history. (Same as Cinema Studies 433.)
Comment(s): Available for art history credit.

435 Cinematography as Art (4) Continued development of concepts and techniques for the creation of film as an art form with an emphasis on individual projects. (Same as Cinema Studies 435.)
Repeatability: May be repeated. Maximum 12 hours.
(DE) Prerequisite(s): 235 and 330 or consent of instructor.

436 Video Art (4) Continued development of concepts and techniques for the creation of video works as an art form with emphasis on individual projects. (Same as Cinema Studies 436.)
Repeatability: May be repeated. Maximum 12 hours.
(DE) Prerequisite(s): 236 and 330 or consent of instructor.

439 Special Topics in Media Arts (3) Student- or instructor-initiated course offered at convenience of department.
Repeatability: May be repeated. Maximum 12 hours.

531 Photography I (2-6)
Repeatability: May be repeated. Maximum 10 hours.

532 Photography II (2-6)
Repeatability: May be repeated. Maximum 10 hours.

535 Media Arts I (2-6)
Repeatability: May be repeated. Maximum 10 hours.

536 Media Arts II (2-6)
Repeatability: May be repeated. Maximum 10 hours.

577 Studies in Media as Art (3) Selected topics in theory and history of media as art form.
Repeatability: May be repeated. Maximum 9 hours.

593 Independent Study (1-4)
Registration Permission: Consent of instructor.

595 Visiting Artist Seminar (3) Contemporary art issues by different visiting artists.
Repeatability: May be repeated. Maximum 12 hours.
Credit Restriction(s): May not be applied toward the art history requirement.

599 Projects in Lieu of Thesis (10)
Grading Restriction: Satisfactory/No Credit grading only.
Comment(s): Completion of all graduate coursework and successful second-year evaluation by graduate faculty required.

Art Painting (138)

413 Painting IV (6) Advanced painting stressing individual concepts and personal expression with varied media.
Repeatability: May be repeated. Maximum 12 hours.
(DE) Prerequisite(s): 313.

415 Watercolor IV (6) Advanced painting with water-based media on paper stressing individual concepts and personal approaches.
Repeatability: May be repeated. Maximum 12 hours.
(DE) Prerequisite(s): 315.

419 Special Topics in Drawing and Painting (3) Student- or instructor-initiated course offered at convenience of department to enhance and expand the painting, drawing, and watercolor curriculum.
Repeatability: May be repeated. Maximum 12 hours.
Registration Permission: Consent of instructor.

513 Graduate Painting I (2-6)
Repeatability: May be repeated. Maximum 10 hours.

514 Graduate Painting II (2-6)
Repeatability: May be repeated. Maximum 10 hours.

593 Independent Study (1-4)
Repeatability: May be repeated. Maximum 15 hours.
Registration Permission: Consent of instructor.

595 Visiting Artist Seminar (2) Contemporary art issues by different visiting artists.
Repeatability: May be repeated. Maximum 8 hours.
Credit Restriction(s): May not be applied toward the art history requirement.

599 Projects in Lieu of Thesis (10)
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated. Maximum 15 hours.

Art Printmaking (132)

461 Advanced Print Workshop (1-6) Individual and collaborative studio work encompassing theory and practice in intaglio, lithography, relief printing, screenprinting, monoprint, papermaking, book arts, and/or photo-print processes.
Repeatability: Not repeatable. May be taken once for 2-6 hours.

462 Advanced Print Workshop (II) (2-6) Directed exploration of any or all matrix-based imaging: intaglio, relief, lithography, screen printing, photo-print methods, and monoprint.
Repeatability: Not repeatable. May be taken once for 2-6 hours.
(DE) Prerequisite(s): 561.

463 Advanced Print Workshop (III) (2-6) Directed exploration of any or all matrix-based imaging: intaglio, relief, lithography, screen printing, photo-print methods, and monoprint.
Repeatability: Not repeatable. May be taken once for 2-6 hours.
(DE) Prerequisite(s): 561 and 562.

464 Advanced Print Workshop (IV) (2-6) Directed exploration of any or all matrix-based imaging: intaglio, relief, lithography, screen printing, photo-print methods, and monoprint.
Repeatability: Not repeatable. May be taken once for 2-6 hours.
(DE) Prerequisite(s): 561, 562, and 563.

593 Independent Study (1-6)
Repeatability: May be repeated. Maximum 15 hours.
Registration Permission: Consent of instructor.

595 Visiting Artist Seminar (2) Contemporary art issues by different visiting artists.
Repeatability: May be repeated. Maximum 8 hours.
Credit Restriction: May not be applied toward the art history requirement.

599 Projects in Lieu of Thesis (10)
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated. Maximum 20 hours.
Comment(s): Completion of all graduate coursework and successful second-year evaluation by graduate faculty required.
Art Sculpture (143)
441 Advanced Sculpture (3) Individual development of sculptural problems and techniques. Students work independently while participating in group projects, critique, and discussion.
Repeatability: May be repeated. Maximum 12 hours.
Recommended Background: 6 hours of 300-level sculpture.

449 Special Topics in Sculpture (3) Student- or instructor-initiated course offered at convenience of department.
Repeatability: May be repeated. Maximum 12 hours.
Recommended Background: Successful completion of any portfolio review.

541 Graduate Sculpture I (2-6)
Repeatability: May be repeated. Maximum 10 hours.

542 Graduate Sculpture II (2-6)
Repeatability: May be repeated. Maximum 10 hours.

593 Independent Study (1-4)
Repeatability: May be repeated. Maximum 15 hours.
Registration Permission: Consent of instructor.

595 Visiting Artist Seminar (2) Contemporary art issues by different visiting artists.
Repeatability: May be repeated. Maximum 8 hours.
Credit Restriction: May not be applied toward the art history requirement.

Asian Languages (144)
431 Readings in Chinese Literature (3) (Same as Chinese 431.)
Recommended Background: Mastery of intermediate-level Chinese or consent of instructor.

451 Readings in Pre-Modern Japanese Literature (3) (Same as Japanese 451.)
Recommended Background: Mastery of intermediate-level Japanese or consent of instructor.

452 Readings in Modern Japanese Literature (3) (Same as Japanese 452.)
Recommended Background: Mastery of intermediate-level Japanese or consent of instructor.

Asian Studies (145)
471 Selected Topics in Asian Studies (3) Content varies.
Repeatability: May be repeated. Maximum 9 hours.

510 Special Topics (3)
Repeatability: May be repeated. Maximum 6 hours.

Astronomy (150)
411 Astrophysics (3) Development of analytical physical models of galactic structure of the universe, stellar and interstellar matter, and planetary systems. Topical and interdisciplinary approach includes consideration of quasiars, pulsars, black holes and current developments in the field. Acceptable for credit toward the physics major.
(De) Prerequisite(s): Physics 136 or 138 or 222 or 232.
Registration Permission: Consent of instructor.

490 Special Topics in Astronomy (1-3) Topics of current interest in astronomy and astrophysics. Acceptable for graduate credit in physics with consent of department.
Repeatability: May be repeated with consent of department. Maximum 9 hours.

Audiology and Speech Pathology (160)
(De) Prerequisite(s): 300 or consent of instructor.

433 Observation of Clinical Practice (1)
(De) Prerequisite(s): 320 or consent of instructor.

434 Clinical Practice in Speech-Language Pathology II (1-4)
Repeatability: May be repeated. Maximum 4 hours.
(De) Prerequisite(s): 433.
Comment(s): Enrollment for fewer than 2 hours must have prior departmental approval.

435 Introduction to Speech Sound Disorders (3) Etiology, diagnosis, and treatment of articulatory and phonological disorders.
(De) Prerequisite(s): 300 and 305 or consent of instructor.

(De) Prerequisite(s): 300 and 306 or consent of instructor.

455 Problems in Speech Pathology (1-3)
Repeatability: May be repeated. Maximum 6 hours.
Registration Permission: Consent of instructor.

461 Introduction to Language Pathology in Children (3) Etiology, diagnosis, and treatment of language impairments in children.
(De) Prerequisite(s): 320 or consent of instructor.

473 Introduction to Audiologic Assessment (3) Basic principles of clinical audiometry, pure tone, speech, masking and overview of specialauditory tests.
(De) Prerequisite(s): 300.
Registration Permission: Consent of instructor.

475 Appraisal of Speech and Language Disorders (3) Diagnostic procedures for children and adults with speech and language problems including observation and practice with diagnostic tests.
(De) Prerequisite(s): 300.
Registration Permission: Consent of instructor.

494 Introduction to Aural Habilitation/Rehabilitation of the Hearing Impaired (3) Introduction to psychosocial aspects, amplification components/characteristics, assistive devices, speech acoustics, speech perception, speech reading, parent-infant, preschool and school years of children, communication impairments/handicaps/remediation of adults, effects of aging/remediation on the elderly, and case studies.
(De) Prerequisite(s): 305 and 473 or consent of instructor.

500 Thesis (1-15)
Grading Restriction: P/NP only.
Repeatability: May be repeated.

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated.
Credit Restriction: May not be used toward degree requirements.

506 Neural Bases of Speech and Language (3) Structure and function of central and peripheral nervous systems, role in speech and language.
(De) Prerequisite(s): 306.

507 Anatomy and Physiology of Hearing (3) Structure and function of the peripheral and central auditory systems, and their roles in mediating auditory processes.
(De) Prerequisite(s): 473 or consent of instructor.

510 Clinical Education Seminar in Audiology (1) Seminar provides a forum for deliberation on issues impacting audiology practice in a variety of clinical and educational settings to help the graduate student clinician transition to their independent practice roles.
Repeatability: May be repeated. Maximum 6 hours.
(De) Corequisite(s): 512 or 515.

511 Introduction to Research in Speech and Hearing (3) Analysis of research techniques, fundamentals of statistics, application of statistics, and completion of a proposal and hypothetical pilot research project.

512 Clinical Practice in Audiology (1-4)
Repeatability: May be repeated. Maximum 24 hours.
(De) Corequisite(s): 546.

515 Practicum in Aural Rehabilitation (1-4)
Repeatability: May be repeated. Maximum 9 hours.
(De) Prerequisite(s): 473 and 494.

516 Language Sample Analysis (3) Methods of characterizing and describing language behaviors.
(De) Prerequisite(s): 320 or equivalent.

518 Adult Neurogenic Communication Disorders I (3) This course will assist students in developing basic biological, social, clinical, and theoretical understandings of commonly observed neurological impairments.
(De) Prerequisite(s): 506 or consent of instructor.

519 Adult Neurogenic Communication Disorders II (3) This course will assist students in developing an advanced understanding of the neural, behavioral, social, clinical, and theoretical understandings of acquired neurological cognitive-linguistic impairments.
(De) Prerequisite(s): 506 and 518 or consent of instructor.

522 Seminar in Speech Sound Disorders (3) Current research in diagnosis and management of speech sound disorders.
(De) Prerequisite(s): 435 or consent of instructor.

(De) Prerequisite(s): 440 or consent of instructor.
COURSES OF INSTRUCTION

525 Counseling and Communication Disorders (3) Issues related to the role of counseling in clinical practice in speech pathology and audiology. Includes discussion of counseling needs and approaches, including multicultural issues.

526 Dysphagia (3) Clinical diagnosis, evaluation, and treatment of adult swallowing disorders and critical interpretation of research literature on dysphagia.
(IE) Prerequisite(s): 506 or consent of instructor.

527 Language, Culture, and Communication Disorders (3) Multicultural issues across the lifespan; theoretical rationales for speech and language development and use, assessment and treatment practices.

531 Seminar on Stuttering (3) Current significant research in stuttering.
(IE) Prerequisite(s): 431 or consent of instructor.

533 Advanced Clinical Practice in Speech-Language Pathology (1-4)
Repeatability: May be repeated. Maximum 15 hours.
(IE) Prerequisite(s): 434 or equivalent.
Comment(s): Enrollment for fewer than 2 hours must have prior departmental approval.
Registration Permission: Consent of instructor.

534 Advanced Clinical Practice in Speech-Language Pathology (1-4)
Repeatability: May be repeated. Maximum 15 hours.
Comment(s): Enrollment for fewer than 2 hours must have prior departmental approval.
Registration Permission: Consent of instructor.

535 Advanced Clinical Practice in Speech-Language Pathology: Off-Campus Sites (1-4)
Repeatability: May be repeated. Maximum 15 hours.
Recommended Background: 100 hours clinical experience.
Comment(s): Enrollment for fewer than 2 hours must have prior departmental approval.
Registration Permission: Consent of instructor.

538 Advanced Clinical Practice in Speech-Language Pathology: Public Schools (1-4)
Repeatability: May be repeated. Maximum 15 hours.
Comment(s): Enrollment for fewer than 2 hours must have prior departmental approval.

539 Motor Speech Disorders (3) Neuromotor organization for speech production; types of motor speech disorders and associated neuromuscular symptomatology; diagnosis and management of motor speech disorders.
(IE) Prerequisite(s): 506.

540 Structural Speech Disorders (3) Etiology, diagnosis and clinical management of craniofacial and resonance disorders.
(IE) Prerequisite(s): 306 and 435.

541 Pediatric Oromotor Disorders (3) Evaluation, diagnosis, and treatment of pediatric oromotor disabilities that affect normal acquisition of feeding and pre-speech skills.
(IE) Prerequisite(s): 506 or consent of instructor.

542 Hearing Disorders (3) Effects of heredity, development/aging, diseases, and physical agents on hearing.
(IE) Prerequisite(s): 473 or consent of instructor.

543 Amplification Technology (3) Description of hearing aid circuits, components and performance characteristics. Electroacoustical and ear canal analysis of hearing aids. Coupler material and geometry effects. Practical experience in troubleshooting, repair, and construction of hearing aids.
(IE) Prerequisite(s): 473 and 507 or consent of instructor.

(IE) Prerequisite(s): 473, 507, and 543 or consent of instructor.

545 Sound Measurement Techniques and Hearing Conservation (2) Techniques of measurement and analysis of sound: hearing conservation in schools and industry.
Registration Permission: Consent of instructor.

546 Audiologic Assessment (3) Theoretical bases for behavioral audiology and acoustic immittance measurement.

547 Special Problems in Audiology (1-3)
Repeatability: May be repeated. Maximum 6 hours.
(IE) Prerequisite(s): 473 or equivalent.
Registration Permission: Consent of instructor.

552 Seminar in Speech Pathology (2-3) Current significant research in speech pathology. Topics vary.
Repeatability: May be repeated with consent of department. Maximum 9 hours.
Recommended Background: 9 hours in speech pathology.

555 Special Problems in Speech-Language Pathology (1-3)
Repeatability: May be repeated. Maximum 6 hours.
Registration Permission: Consent of instructor.

556 Independent Study in Speech-Language Pathology (1-3)
Repeatability: May be repeated. Maximum 6 hours.
Registration Permission: Consent of instructor.

558 Phonological Disorders (3) Current theories and approaches to assessment and intervention for individuals with difficulty acquiring or using speech sound system of English.
(IE) Prerequisite(s): 435 or consent of instructor.

561 Child Language Disorders (3) Current literature on assessment and intervention techniques for young language learners.
(IE) Prerequisite(s): 461 or consent of instructor.

563 Language Disorders: Birth to Three (3) Overview of family-focused, transdisciplinary intervention process. Assessment/treatment of infants, toddlers, and preschoolers. Description of disabilities and resulting communication disorders.
(IE) Prerequisite(s): 461 or consent of instructor.

573 Pediatric Audiology for Education Professionals (3) Basic principles in the identification and management of hearing loss in infants and children; social and psychological concomitants of auditory disorder; genetic hearing loss and other high-risk types of impairment related to hearing; educational alternatives and state and federal guidelines.
Credit Restriction: Students with credit in 574 cannot receive credit for 573.
(IE) Prerequisite(s): 473.

574 Pediatric Audiology for Audiology Majors (3) Theoretical and practical considerations in evaluation and treatment of hearing loss in infants and children. Audiological intervention in case management of hearing-impaired child; amplification, educational alternatives, and state and federal guidelines.
Credit Restriction: Students with credit in 573 may also receive credit for 574.
(IE) Prerequisite(s): 507, 546, and 576.
Registration Restriction(s): Audiology major.

576 Physiologic Assessment of the Auditory System I (4) Otoacoustic emissions, electrocochleography, and auditory brainstem responses. Anatomical origins, principles, and applications. Use of these responses in evaluation of auditory function and determination of site-of-lesion.
Contact hour distribution: 3 hours lecture and 1 hour lab.
(IE) Prerequisite(s): 507 and 546 or consent of instructor.

577 Vestibular Disorders (3) Anatomy, physiology, and pathophysiology of vestibular system and other systems that contribute to balance. Practicum in electroneystagmography.
(IE) Prerequisite(s): 507, 542, 546, and 576 or consent of instructor.

581 Assessment of Central Auditory Processing (3) Overview of current central auditory processing disorder (CAPD) literature and assessment procedures, with emphasis on a holistic view by combining perceptual, electrophysiological, linguistic, and cognitive measurements.
(IE) Prerequisite(s): 546, 574, and 594 or consent of instructor.

582 Speech and Language Services in School (3) Organization and implementation of speech and language programs in schools.

583 Physiologic Assessment of the Auditory System II (3) Middle-latency, long-latency, and event-related potentials. Neurophysiological mechanisms, principles, and applications. Use of these potentials in evaluation of neurological and cognitive function.
(IE) Prerequisite(s): 576 or consent of instructor.

584 Amplification for Children with Hearing-Impairment (3) Study of strategies for selecting and fitting amplification systems for children; outcome measures and service coordination.
(IE) Prerequisite(s): 543, 544, and 574 or consent of instructor.

585 Cochlear Implants (3) Overview of cochlear implants, focusing on theory of auditory stimulation and cochlear implant systems; candidacy, surgical preparation, and follow-up/outcome measures; the rehabilitation process; and cochlear implant case presentations.
(IE) Prerequisite(s): 507, 576, and 593 or consent of instructor.

586 Standards and Practice Issues in Audiology (3) Overview of professional practice standards, ethics, medical/legal issues, business practices, and reimbursement procedures in audiology.
(IE) Prerequisite(s): 512 or consent of instructor.

591 Foreign Study (1-15)
Repeatability: May be repeated. Maximum 30 hours.
592 Off-Campus Study (1-15)  
Repeatability: May be repeated. Maximum 30 hours.

593 Independent Study (1-15)  
Repeatability: May be repeated. Maximum 15 hours.

594 Aural Habilitation/Rehabilitation of the Hearing-Impaired (3)  
Study of grieving process, counseling, group and individual amplification systems, classroom/speech acoustics, central auditory problems, therapy methods for habilitation and rehabilitation, speech reading, school-based programs, programs for adults and the elderly; student research reports/case studies.  
(DE) Prerequisite(s): 473 and 494 or consent of instructor.

595 The Verbotonal System: Auditory/Speech Perception (3)  
Innovative theory, therapy procedures, and SUVAG amplification/filters for diagnosis/evaluation/remediation of spoken language/listening skills of hearing-impaired children/adults: use of rhythms, movements, and suprasegmentals; special audiometric tests, acoustic filters, correcting misarticulations through optimal listening; central auditory treatment; second (foreign) language through listening/spoken language; relationship of concepts to conventional concepts/practice; student research reports.  
(DE) Prerequisite(s): 305, 473, and 494 or consent of instructor.

600 Doctoral Research and Dissertation (3-15)  
Grading Restriction: P/NP only.  
Repeatability: May be repeated.  
Registration Permission: Consent of academic advisor.

601 Experimental Phonetics (3)  
Acoustical and perceptual analyses of speech production and overall oral communication.  
Registration Permission: Consent of instructor.

602 Psychoacoustics (3)  
Auditory perception and reception of acoustic stimuli.  
(DE) Prerequisite(s): 507 or consent of instructor.

603 Molecular Genetics and Pharmacology of Hearing (3)  
Study of genetics, pharmacology, and general cellular processes as they relate to hearing.  
(DE) Prerequisite(s): 507 or consent of instructor.

605 Speech Perception and Hearing Impairment (3)  
Study of perception of speech stimuli, with particular emphases on the effects of hearing impairment on perception.

611 Experimental Design in Speech and Hearing (3)  
Analysis of experimental design in theses and related journals. Generation of experimental designs.  
Registration Permission: Consent of instructor.

613 Externship in Audiology (1-9)  
Off-campus clinical training experience.  
Repeatability: May be repeated. Maximum 36 hours.  
Registration Permission: Consent of academic advisor.

626 Advanced Seminar in Neurologically-based Communication Disorders (3)  
Topics vary.  
Repeatability: May be repeated. Maximum 6 hours.  
(DE) Prerequisite(s): 518 and 526.

650 Advanced Seminar in Audiology (3-6)  
Topics vary.  
Repeatability: May be repeated. Maximum 9 hours.  
Registration Permission: Consent of instructor.

655 Practicum in College Teaching (1-3)  
Supervised experience in college teaching.  
Grading Restriction: Satisfactory/No Credit grading only.  
Repeatability: May be repeated. Maximum 6 hours.  
Registration Permission: Consent of instructor.

656 Directed Research (1-4)  
Participation in ongoing or non-dissertational research.  
Repeatability: May be repeated. Maximum 9 hours.  
Registration Permission: Consent of instructor.

657 Directed Study in Speech Pathology (1-3)  
Repeatability: May be repeated. Maximum 9 hours.  
Registration Permission: Consent of instructor.

658 Directed Study in Audiology (1-3)  
Repeatability: May be repeated. Maximum 9 hours.  
Registration Permission: Consent of instructor.

659 Directed Study in Speech Science (1-3)  
Repeatability: May be repeated. Maximum 9 hours.  
Registration Permission: Consent of instructor.

660 Directed Study in Hearing Science (1-3)  
Repeatability: May be repeated. Maximum 9 hours.  
Registration Permission: Consent of instructor.

661 Advanced Seminar: Language Disorders in Children (3)  
Topics vary.  
Repeatability: May be repeated. Maximum 6 hours.  
(DE) Prerequisite(s): 561 or consent of instructor.

662 Advanced Seminar in Audiologic Assessment (3)  
Synthesis of information on audiologic and vestibular assessment and application of clinical cases.  
(DE) Prerequisite(s): 542, 546, 574, 576, and 577 or consent of instructor.

663 Advanced Seminar in Aural Habilitation/Rehabilitation (3)  
Synthesis of information on audiologic habilitation and rehabilitation cases.  
(DE) Prerequisite(s): 543, 544, 584, and 594 or consent of instructor.

664 Advanced Seminar in Amplification (3)  
Synthesis of information on amplification technology, amplification for adults with hearing impairment, and case studies.  
(DE) Prerequisite(s): 543, 544, 584, and 594 or consent of instructor.

Aviation Systems (169)

500 Thesis (1-15)  
Grading Restriction: P/NP only.  
Repeatability: May be repeated.  
Registration for Use of Facilities (1-15)  
Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed.  
Grading Restriction: Satisfactory/No Credit grading only.  
Repeatability: May be repeated.  
Credit Restriction: May not be used toward degree requirements.

503 Air Vehicles (3)  
Current capabilities and future requirements for civilian and military air vehicles. Parameters significant for air vehicle type selection. Integration of air vehicle into aviation systems.  
(DE) Prerequisite(s): 518.

506 Aircraft Design (3)  
Design process, compromise of conflicting requirements, economical, industrial, and legal aspects. Definition of mission requirements, synthesis and optimization techniques, safety and reliability, systems integration, standards and regulations, teamwork, and decision-making process.

507 Introduction to Airborne Radar (3)  
Theory and application of airborne radar. Radar detection and measurement techniques through aviation systems applications. Ground effects on radar signals of multipath and clutter. Pulsed operation, coding, filters, processing techniques, Doppler effects. Problems of range and range rate and tracking. Methods and techniques for reducing radar cross section.

508 Flight Test Instrumentation (3)  
Principles of measurement, measuring devices with views toward both ground and flight aerospace testing: measurement fundamentals, sensors for specific parameters (e.g. temperature, heat flux, flow rate, pressure, acceleration, vibration, strain, and humidity), data bus integration, signal condition, telemetry, and fabrication.

509 Introduction to Aircraft Structures (3)  
Design and analysis of structures: light-weight and modern materials used for aircraft structures. Topics: load determination and aviation regulations, airworthiness, ultimate loads, load limits, load factors; simplifying assumptions to safe side; basics of stress and strain, elasticity, shear, bending, torsion; statically indeterminate systems, frames; structural instabilities, buckling of columns, thin plates; tension field beams; principles of stressed skin construction; open, closed, thin-walled beams; tapered beams, fuselages and frames, wings and ribs; laminated composite structures; elementary aeroelasticity.

510 Special Topics in Aviation Systems (3)  
Current problems.  
Repeatability: May be repeated. Maximum 15 hours.  
Registration Permission: Consent of instructor.  
Credit Restriction: Maximum of 12 hours may be applied toward degree requirements.

512 Helicopter Performance Flight Test Techniques (3)  
Experimental test techniques for helicopter performance flight testing. Theoretical derivation of flight test techniques. Participation in series of flight test experiments demonstrating acquisition of flight test data. Instrumentation and data reduction techniques.

513 Helicopter Stability and Control Flight Test Techniques (3)  
Experimental test techniques for helicopter stability and control flight testing. Theoretical derivation of flight test techniques. Participation in series of flight test experiments demonstrating acquisition of flight test data. Instrumentation and data reduction techniques.
515 Aviation Human Factors (3) Human factors pertinent to aviation: concept of human factors, human error, fatigue, body rhythms, performances, motivation, vision and visual illusions, communication, attitudes, training and devices, displays and controls, space and layout, anthropometry, flight deck design and evaluation, aircraft cabin design and evaluation, flying qualities evaluation, and performance measurement techniques. Applied aviation systems.

516 Aircraft Flight Controls (3) Feedback control concepts, root locus techniques, bode analysis, PID control design, and controller and observer design concepts applied to aircraft. Complex analysis and matrix algebra.

517 Systems Flight Testing (3) Civil airworthiness requirements for development and certification of large fixed wing transport category aircraft. FAA regulatory and advisory information is explained and applications are made to systems flight test planning and execution. Flight test examples are provided and major aircraft systems to include hydraulic, propulsion, electrical, avionics, autopilot, pneumatic, and ice protection.

518 Aviation systems: an overview (3) Introduction to aviation systems and the discipline of flight test engineering. Topics: aviation fundamentals, basic airmanship, aerospace mathematics and physics, basic aerodynamics, performance, and stability and control, flight test instrumentation and data acquisition, flight test fundamentals, and flight test data analysis and reporting. Course structure will be weekly classroom academics with 3 flight labs during the semester. Course is designed for full time attendance during the semester and will not be offered as a distance learning course.

521 Experimental Flight Mechanics (3) Performance. Experimental techniques for flight mechanics. Specially equipped airborne laboratory: student participation in series of experiments demonstrating acquisition of flight test data. Necessary theory supports class experiments. Tests cover broad range of aircraft performance, stability and control characteristics in addition to instrumentation and data reduction methods.

522 Experimental Flight Mechanics (3) Stability and control. Experimental techniques for flight mechanics. Specially equipped airborne laboratory: student participation in series of experiments demonstrating acquisition of flight test data. Necessary theory supports class experiments. Tests cover broad range of aircraft performance, stability and control characteristics in addition to instrumentation and data reduction methods.

550 Project in Aviation Systems (3) Repeatability: May be repeated. Maximum 15 hours. Credit Restriction: Maximum of 3 hours may be applied toward degree requirements. Comment(s): Non-thesis aviation systems majors only.

Biochemistry and Cellular and Molecular Biology (188)

401 Biochemistry-Molecular Biology I (4) First semester of a two-course sequence providing in-depth coverage of biochemistry and molecular biology. Covers structure of DNA and RNA, experimental methods of analyzing nucleic acids, mechanisms of RNA and protein synthesis, mechanisms of DNA replication, repair and recombination, chromosome structure and function, regulation of gene expression, genome structure and genomics, and mechanisms of biological regulation.

402 Biochemistry-Molecular Biology II (4) Second semester of a two-course sequence providing in-depth coverage of biochemistry and molecular biology. Covers structure of DNA and RNA, experimental methods of analyzing nucleic acids, mechanisms of RNA and protein synthesis, mechanisms of DNA replication, repair and recombination, chromosome structure and function, regulation of gene expression, genome structure and genomics, and mechanisms of biological regulation.

403 Advanced Genetics Laboratory (3) Experiments illustrating methods in modern genetics: techniques in classical, cyto-molecular, and developmental genetics. Using model organisms, especially Drosophila and mouse.

419 Cellular and Comparative Biochemistry Lab (2) Experiments with enzymes, nucleic acids, and membranes and organelles. Chromatography, kinetics, hybridization, sequencing, and immunological techniques.

421 Cell and Tissue Structure and Function (4) Study of animal cells and tissues at light and electron microscope levels. Contact Hour Distribution: 2 hours and 2 labs.

440 General Physiology (3) Principles of cellular and organ-system animal physiology.

445 Human Genetics (3) Genetic and molecular problems of human inheritance.

471 Biophysical Chemistry (3) Physicochemical principles with applications to biological systems. Thermodynamics; chemical equilibrium; solution chemistry; transport, electrophoresis; kinetics; enzyme catalyzed reactions. (Same as Chemistry 471.)

480 Physiology of Exercise (3) (See Exercise Science 480.)

481 Biophysical Chemistry (3) Physicochemical principles with applications to biological systems. Elementary quantum chemistry; interactions of light with biological molecules; optical and magnetic spectrosopy; light scattering; case studies of selected macromolecules. (Same as Chemistry 481.)

500 Thesis (1-15) Graduation Restriction: P/NP only. Repeatability: May be repeated.

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed. Grading Restriction: Satisfactory/No Credit grading only. Repeatability: May be repeated. Credit Restriction: May not be used toward degree requirements.

510 Computational Structural Biochemistry (1) Introduction to computational tools, internet resources and databases for biological research to analyze and model protein structures and to study protein-ligand interactions.

511 Advanced Protein Chemistry and Cellular Biology (3) Cellular structure and function at molecular and supramolecular level in progression: protein structure and function; membrane structure and function; bioenergetics and membrane proteins.

512 Advanced Molecular Biology (3) Regulation of nucleic acid expression and protein activity. Nucleic acid structure and function; replication and repair of nucleic acids; gene expression; protein synthesis; post-translational protein modification; mitosis and meiosis; cell cycle and cell growth. Credit Restriction: May not be used toward degree requirements.

513 Advanced Protein Biochemistry and Cell Biology II (3) Advanced topics of cellular function and regulation of cell division and growth, and structure and function of supramolecular structures: cytoskeleton and cell junctions and adhesions.

515 Experimental Techniques I (2-4) Introduction to modern experimental methodology and instrumentation in biochemistry, molecular biology, and cell biology, including cell culture; spectrophotometry; microscopy; nucleic acid purification and analysis; protein assays; enzyme purification; electrophoresis; computer analysis of nucleic acid and protein sequences. Team-taught lecture/demonstration format. Repeatability: May be repeated. Maximum 6 hours. Comment(s): Primarily for departmental graduate students.

516 Experimental Techniques II (2-4) Laboratory rotations. Students work in laboratory of faculty member on clearly defined project. Written proposal and oral report required. Repeatability: May be repeated. Maximum 8 hours. Credit Restriction: May not be used toward degree requirements.

517 Physical Biochemistry (3) Physics and chemistry of biological systems and molecules. Thermodynamics; diffusion and transport; physical chemistry of macromolecules; enzyme kinetics; binding reactions; spectroscopy; electrophoresy.
520 Special Topics (1-3) Selected directed readings or special course in topics of current interest. Consult departmental listings for offerings.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated with consent of instructor. Maximum 6 hours.

(DE) Prerequisite(s): 401 and one semester of introductory plant physiology or cell biology.

523 Advanced Plant Physiology II (3) Growth and differentiation of plants at molecular, cellular and organismal levels. Regulation of development; macromolecular interpretation of differentiation, dormancy, germination, flowering, and senescence.
(DE) Prerequisite(s): 401 and one semester of introductory plant physiology or cell biology.

525 Graduate Research Participation (3-12) Tutorial laboratory experience.
Repeatability: May be repeated. Maximum 12 hours.

530 Experimental Design and Analysis (3) Development of skills in strategies of experimental design and interpretation of experimental results. Critical discussion of research articles illustrating issues in experimental design. Preparation of grant proposal in standard format to be read and discussed by class and by panel of faculty expert in area of proposal.
Registration Permission: Consent of instructor.

550 Advanced Concepts in Neurobiology/Physiology (3) Concepts related to neurobiology/physiology with information taken from current literature. Predominantly lecture format with student participation. Specific subject area to be announced.
Registration Permission: Consent of instructor.

552 Physiology of Hormones (3) Cellular and organismal action of hormones in invertebrate and vertebrate animals. (Same as Animal Science 556.)
Recommended Background: 402, 440 or equivalent courses.
Registration Permission: Consent of instructor.

559 Biophysical Crystallography (3) Theories and practices of X-ray diffraction, neutron diffraction and neutron scattering to elucidate the structure of nucleic acids, proteins, nucleosomes, ribosomes and viruses. Application of 3-D structures in designing drugs against AIDS, cancer, cardiac disease and neurodegenerative disorders.
Recommended Background: 401 or two 300-level chemistry courses or Physics 240.
Registration Permission: Consent of instructor.

560 Advanced Concepts in Structural Biology/Biochemistry (3) Concepts related to structural biology/biochemistry with information taken from current literature. Predominantly lecture format with student participation. Specific subject area to be announced.
Repeatability: May be repeated. Maximum 12 hours.
Registration Permission: Consent of instructor.

Contact Hour Distribution: Two 3-hour labs.
Comment(s): Approved graduate students in department only.

564 Introduction to Electron Microscopy-Scanning Electron Microscope (3) Practical introduction to techniques of electron microscopy and to scanning electron microscope. Use of microscope, introduction to darkroom techniques and digital image processing, preparation of samples for observation, and special projects.
Contact Hour Distribution: 2 hours and 1 lab.
Registration Permission: Consent of instructor.

Repeatability: May be repeated. Maximum 12 hours.
Registration Permission: Consent of instructor.

591 Foreign Study (1-15) Repeatability: May be repeated. Maximum 15 hours.

592 Off-Campus Study (1-15) Repeatability: May be repeated. Maximum 15 hours.

593 Independent Study (1-15) Repeatability: May be repeated. Maximum 15 hours.

600 Doctoral Research and Dissertation (3-15) Grading Restriction: P/NP only.
Repeatability: May be repeated.

601 Departmental Seminar (1) Invited speakers. Topics posted in advance. Required every semester in residence.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated. Maximum 15 hours.

603 Graduate Research Colloquium (1) Seminars and lectures dealing with current advances in fields of biochemical and biophysical methods. Mechanisms of enzyme catalysis, gene expression, membrane structure and function, metabolic regulation, physical biochemistry, molecular genetics, cell biology, neurobiology, and related topics. Topics posted in advance. Required every semester in residence.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated. Maximum 15 hours.

605 Journal Club in Neurophysiology/Physiology (1) Readings and discussion based on current literature.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated. Maximum 12 hours.

606 Journal Club in Structural Biology/Biochemistry (1) Readings and discussion based on current literature.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated. Maximum 12 hours.

607 Journal Club in Cellular/Molecular Biology (1) Readings and discussion based on current literature.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated. Maximum 12 hours.

608 Journal Club in Genetics/Developmental Biology (1) Readings and discussion based on current literature.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated. Maximum 12 hours.

610 Current Topics in Biochemistry, Cellular, and Molecular Biology (1-3) Critical reviews of research problems and methods in biochemistry, cell biology and/or molecular biology. Oral presentations, written reports, computer simulations by faculty and students.
Repeatability: May be repeated. Maximum 4 hours.
Registration Permission: Consent of instructor.

612 Advanced Topics in Environmental Toxicology (1-3) (See Ecology and Evolutionary Biology 612.)

615 Special Topics in Biochemistry, Cellular, and Molecular Biology (3) Biochemical and biophysical methods, mechanisms of enzyme catalysis, gene expression, membrane structure and function, metabolic regulation, physical biochemistry, molecular genetics, cell ultrastructure and physiology, neurobiology, and related topics.
Repeatability: May be repeated. Maximum 9 hours.
(De) Prerequisite(s): 511 and 512 or consent of instructor.

Biomedical Engineering (192)

(DE) Prerequisite(s): Biochemistry and Cellular and Molecular Biology 230 or Bio-610logy 140.

430 Biomedical Engineering Laboratory (3) Experience with the unique problems associated with making measurements and interpreting data in living systems. Experiments may include mechanical testing of biological materials, imaging and physiological measurements (EKG, EMG, ECG, etc.).
(DE) Prerequisite(s): 345 and Electrical and Computer Engineering 300.

473 Applied Biomechanics (3) Applications of biomechanics to the industrial and orthopedic area. Design of orthopedic implant devices; biomechanics of injury and protection.
(DE) Prerequisite(s): Mechanical Engineering 321.
(DE) Corequisite(s): 310 and Materials Science and Engineering 474.

474 Biomaterials (3) (See Materials Science and Engineering 474.)

475 Design of Artificial Internal Organs (3) Design, development and evaluation of artificial internal organs; analysis of transport processes in therapeutic devices for design optimization; current research and development needs. Ethical considerations.
(DE) Prerequisite(s): Aerospace Engineering 341 and Mathematics 231.

494 Special Project in Biomedical Engineering (1-3) Problems related to recent developments and practice.
Repeatability: May be repeated. Maximum 6 hours.
495 Special Project in Biomedical Engineering (1-3) Problems related to recent developments and practice. 
Repeatability: May be repeated. Maximum 6 hours.

500 Thesis (1-15) Grading Restriction: P/NP only. 
Repeatability: May be repeated.

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed. 
Grading Restriction: Satisfactory/No Credit grading only. 
Repeatability: May be repeated. 
Credit Restriction: May not be used toward degree requirements.

507 Application of Linear Algebra in Engineering Systems (3) (See Chemical Engineering 507.)

509 Multidisciplinary Project (1) (See Industrial Engineering 509.)

511 Biotransport Processes (3) Cellular transport and electrical properties from a combined biological, physical, and engineering point of view. Matter transport across cellular membranes involving diffusion, osmosis, coupled solute and solvent transport, carrier-mediated transport, and ion transport. Homeostatic mechanisms involved in maintaining cellular solute concentrations, volume, and potential. Electrically inexorable and excitable cells, lumped parameter and distributed-parameter cell models, linear electric properties of cells, and voltage gated ion channels. 
(DE) Prerequisite(s): Electrical and Computer Engineering 301 or consent of instructor.

531 Advanced Biomechanics I (3) Derivation of mathematical models of the human body using Kane's Method of Dynamics to create system equations of motions. Mathematical models will pertain to human non-implanted and implanted joints. Models will be created by hand and using the symbolic manipulation algorithm Autolev. (Same as Mechanical Engineering 531.)

534 Mechanical Vibrations (3) (See Mechanical Engineering 534.)

538 Ultrasonic Methods and Bioinstrumentation (3) Basic ultrasound principles including wave equation, impedance, acoustic properties of biological tissues, etc. Transducers, beam patterns, resolution, and diagnostic imaging configurations for static and dynamic real-time imaging principles. Doppler physics, Doppler spectral analysis, image quality, image artifacts, clinical safety and measurement techniques, and quality control. 
Registration Permission: Consent of instructor.

539 Continuum Mechanics (3) (See Engineering Science 539.)

541 Fluid Mechanics I (3) (See Mechanical Engineering 541.)

547 Modern Linear Controls (3) (See Mechanical Engineering 547.)

548 Optimization Techniques in Biomedical Engineering (3) Current techniques in optimization. Emphasis on applying optimization techniques to problems in biomedical imaging. 
Registration Permission: Consent of instructor.

552 Computational Biomechanics (3) Practical use of general-purpose commercial finite element packages for simulations related to orthopedic and sport biomechanics. Prediction of failure and performance of bone, joints and prosthetic devices. 
(DE) Prerequisite(s): Mechanical Engineering 231 and 321.

555 Human Vibrations Analysis and Protection (3) Concepts of whole body vibrations, background information on the development of ANSI and ISO Standards for the protections of workers from whole body vibrations; how to apply the standards to meet the EU requirements; measurement methods and signal processing requirements for whole body vibration; background information on the development of ANSI and ISO Standards for the protections of workers for vibration white finger syndrome; development criteria for current ANSI, ISO, and EU standards; measurements methods and requirements, effectiveness of anti-vibration gloves. (Same as Aerospace Engineering 555; Mechanical Engineering 555.)

559 Advanced Mechanics of Materials I (3) (See Mechanical Engineering 559.)

561 Finite Elements for Engineering Applications (3) (See Engineering Science 551.)

562 Computational Fluid-Thermal Systems (3) (See Engineering Science 552.)

571 Biomechanics of Hard and Soft Tissue (3) (See Engineering Science 571.)

574 Multidimensional Medical Image Analysis (3) Applied mathematical and physical principles for different medical imaging modalities, image formation, reconstruction, enhancement and filtering, representation and analysis, registration and camera calibration models, shape and texture transforms, features extraction, segmentation, clustering, introduction to pattern recognition and classification based on non-parametric techniques, parametric techniques, and neural networks models, 2D matching, introduction to biometrics, application in medical image segmentation, classification, and computerized medical diagnosis of diseases. 
(DE) Prerequisite(s): 572, and Electrical and Computer Engineering 472.

577 Neural Networks in Engineering (3) (See Nuclear Engineering 577.)

578 Advanced Biomaterials: Biological Applications of Nanomaterials (3) (See Materials Science and Engineering 578.)

582 Micro-electromechanical Systems in Biomedical Engineering (3) Examines physical principles, design techniques, fabrication techniques, and testing technologies needed for the modern biomedical engineer working in the microfabrication field in miniaturized environments. This is a hands-on hardware and software course that includes some laboratory experiments and use of MEMS design software. 
Registration Permission: Consent of instructor.

587 Dynamic Modeling and Simulation (3) (See Mechanical Engineering 587.)

588 Cell and Tissue-Biomaterials Interaction (3) (See Materials Science and Engineering 588.)

590 Selected Biomedical Engineering Problems (2-6) Grading Restriction: Satisfactory/No Credit grading only. 
Repeatability: May be repeated. Maximum 6 hours. 
Comment(s): Enrollment is limited to students in the non-thesis option. 
Registration Permission: Consent of instructor.

595 Seminar (1) All phases of biomedical engineering, reports on current research at UT and UT. 
Grading Restriction: Satisfactory/No Credit grading only. 
Repeatability: May be repeated. Maximum 20 hours.

599 Special Topics in Biomedical Engineering (1-3) 
Repeatability: May be repeated. Maximum 12 hours. 
Registration Permission: Consent of instructor.

600 Doctoral Research and Dissertation (3-15) 
Grading Restriction: P/NP only. 
Repeatability: May be repeated.

610 Advanced Topics in BME (3) Current research topics of interest in biomedical engineering. 
Repeatability: May be repeated. Maximum 9 hours. 
Registration Permission: Consent of instructor.

611 Fields, Forces and Flows in Cells and Tissues (3) Applications of equilibrium and non-equilibrium thermodynamics to rate processes and forces in cells and tissues. Fields in heterogeneous media, electrical double layers, and electromechanical forces in physiological systems. Fluid and solid continuum mechanics of porous hydrated biological tissues. Electrophoretic, electroosmotic flows, and diffusion-reaction. Electromechanical and physicochemical interactions in biomaterials and cells. Case studies in membrane transport, electrode interfaces, electrical, mechanical, and chemical transduction in tissues. Cardiovascular, orthopedic and other clinical examples. 
(DE) Prerequisite(s): 511 or consent of instructor.

631 Advanced Biomechanics II (3) Using the symbolic manipulation algorithm, difficult systems pertaining to the human body will be modeled. A more in depth analysis of Kane's method of multibody dynamics will also be implemented in these models. Each student will focus on one complex model that pertains to an orthopedic complication that the orthopedic industry needs solved. (Same as Mechanical Engineering 631.) 
(DE) Prerequisite(s): 531.

632 Biomechanics Design (3) Design of an implant, orthopaedic mechanical device, orthopaedic instrument or a rehabilitation device for a sponsoring orthopaedic company. The design project will include patent searches, literature searches and a final report. 
(DE) Prerequisite(s): 531.

647 Non Linear Control Systems (3) (See Mechanical Engineering 647.)

659 Advanced Mechanics of Materials II (3) (See Mechanical Engineering 659.)

674 Neuro-Fuzzy Pattern Recognition in Medicine (3) Pattern recognition and computer vision fundamentals, human vision system, principles of image formation and human perception, camera models, sampling and quantization and image transforms. Applications of neuro-fuzzy systems in medicine. 
(DE) Prerequisite(s): 574.
582 Selected Topics in Processing (3) Topics in the engineering of biologi- cal and physical processes and of biological systems, from the produc- tion of raw materials through to high-demand value-added products. Repeatability: May be repeated. Maximum 12 hours.

575 Applied Microbiology and Bioengineering (3) (See Chemical Engi- neering 575.)

591 Environmentally-Sensitive Spray Applications (3) Develops the concept of spray drift causes and corrective actions to lessen the effects of pesticides in the environment. Concepts are based on factors related to dosage transfer and the competing physics of droplet delivery under a va- riety of atmospheric conditions. Mass balance procedures are empha- sized to validate measures of spray drift. Sprayer equipment components and operation factors affecting spray drift are introduced as operator con- trolled measures to minimize spray drift. The role of pesticide label lan- guage is incorporated into course concepts. Best management practices are developed to ensure practical applications of course concepts are em- phasized. The student will learn how to implement spray drift reduction practices as well as make objective conclusions about spray drift test data.

Registration Permission: Consent of instructor.

600 Doctoral Research and Dissertation (3-15) Grading Restriction: P/NP only. Repeatability: May be repeated. Registration Restriction(s): Doctor of Philosophy – biosystems engineering major.

603 Seminar (1) (See Environmental and Soil Sciences 603.)

619 Mathematical Modeling for Engineers (3) Describing physical and biological settings with mathematical expressions. Applying dimensional analysis, linear and nonlinear ordinary differential equations, partial differential equations, systems of linear equations, linearization, moving boundary problems, and series solutions to solve mathematical expressions. (RE) Prerequisite(s): 519.

650 Selected Topics (1-3) Lecture, group discussion, and individual study on specialized developments. Repeatability: May be repeated. Maximum 6 hours.

Biosystems Engineering Technology (194)

412 Surveying (3) Measurement of landforms using radar, remote im- agery, satellite real-time kinematics, and laser-based surveying instru- ments. Survey methods and mapping using GIS. Precision landform measurement of distances, angles, and areas; differential and profile lev- eling; topographic surveying and mapping; data computation. Contact Hour Distribution: 1 hour and one 3-hour lab. Recommended background: college mathematics and computer literacy.

432 Agricultural Machinery and Tractors (3) Functions, selection, matching, and management of agricultural machinery systems. Tractor power ratings, engine and transmission systems, hydraulic systems, hitching, and ballasting. Field and material capacity, field efficiency, cost analyses, and machinery replacement strategies. Functional analyses of tillage operations, planters and drills, no-tillage systems, hay harvest sys- tems, forage and small grain harvesting, and cotton harvesting. Crop dry- ing processes, off-road machinery safety considerations, and operator ergonomics.

Contact Hour Distribution: 2 hours and 1 lab. Recommended Background: 2 semesters of calculus.
442 Agricultural Waste Management and Pollution Control (3) Waste renovation fundamentals; characteristics of animal manure; techniques for collection, transporting, storing, and utilizing livestock waste. Contact Hour Distribution: 2 hours and 1 lab. Recommended Background: 2 semesters of calculus.

452 Small Internal Combustion Engines (3) Theory, concepts, and mechanics of small internal combustion engines; theoretical cycles; selection, operation, adjustment, troubleshooting and repair of single-cylinder engines. Contact Hour Distribution: 2 hours and 1 lab. Recommended Background: 2 semesters of calculus.

462 Agricultural Chemical Application Technology (3) Equipment for application of liquid, solid, and gaseous agricultural chemicals; system components; operational characteristics; calibration; selection and management; safety considerations; materials handling and disposal methods. Contact Hour Distribution: 2 hours and 1 lab. Recommended Background: 2 semesters of calculus.

500 Thesis (1-15) Grading Restriction: P/NP only. Repeatability: May be repeated. Registration Restriction(s): Master of Science – biosystems engineering technol- ogy major.

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses universi- ty facilities and/or faculty time before degree is completed. Grading Restriction: Satisfactory/No Credit grading only. Repeatability: May be repeated. Credit Restriction: May not be used toward degree requirements.

503 Seminar (1) (See Environmental and Soil Sciences 503.)

506 Engineering Principles (3) Properties of materials, fundamentals of hydraulics, principles of electricity, thermal phenomena, applications in biological systems. Contact Hour Distribution: 2 hours and 1 lab.

508 Special Problems in Biosystems Engineering Technology (1-3) Individual studies of current problems. Repeatability: May be repeated. Maximum 6 hours.

514 CAD Applications to Biosystems Engineering Technology (3) Computer Aided Drafting (CAD) applications in agriculture and environ- mental science. Essentials of CAD software to create drawings of compo- nents, systems, flow charts, and process diagrams. Applications in me- chanical, structural, and biosystems. 2-D applications with limited exposure to 3-D applications. Computer intensive course. Hands-on experience. Credit Restriction: Students cannot receive credit for both 414 and 514.

Registration Restriction(s): Minimum student level – graduate.

532 On-Site Domestic Wastewater Treatment, Dispersal, and Reuse (3) (See Biosystems Engineering 532.)

534 Production Monitoring and Automation (3) Precision technologies for monitoring and control of agricultural systems. Applications include: yield monitoring, variable rate control and sensing systems for planters, sprayers, soil applied nutrients, water management, crop health, and pest pressure; electronic information transfer; and GPS-based vehicle guidance. Contact Hour Distribution: 2 hours and 1 lab. Credit Restriction: Students cannot receive credit for both 434 and 534.

Registration Restriction(s): Minimum student level – graduate.

555 GIS and GPS Applications to Biosystems (3) (See Biosystems Engineering 555.)

562 Selected Topics in Biosystems Engineering Technology (1-3) Lecture/group discussion on specialized topics. Repeatability: May be repeated. Maximum 6 hours.

574 Environmental Instrumentation and Monitoring (3) Equipment and techniques commonly used to measure all aspects of hydrologic cycle: precipitation, runoff, streamflow, subsurface water movement. Sampling of all flows for contaminants. Design of monitoring systems. Analysis of data. Contact Hour Distribution: 2 hours and 1 lab. Credit Restriction: Students cannot receive credit for both 474 and 574. (RE) Prerequisite(s): 506. Recommended Background: Hydrology.

Registration Restriction(s): Minimum student level – graduate.

Business Administration (205)

501 MBA Career Development (1) Career opportunities available in each concentration. Grading Restriction: Satisfactory/No Credit grading only. Comment(s): Enrollment is limited to students admitted to the MBA Program or by consent of the Director of the MBA Program.

511 MBA Core I (3) Essential skills of manager: basic information technol- ogy skills, teambuilding, and written and oral communication skills. Finance and accounting fundamentals. Introduction to integrated value chain. Grading Restriction: Satisfactory/No Credit grading only. Comment(s): Requires admission to the MBA program or consent MBA Program Director.

512 MBA Core II (15) Development of roles and responsibilities of busi- ness managers. Functional fundamentals: marketing, operations, human resource management. Continuous systems improvement and delivery of customer value. Role of firm in society, stakeholder value, economics, and ethical and legal environment of firm. Personal leadership skills, and assessment of students’ leadership abilities. Integration of value chain: demand management, operations management, process design and management, and logistics management. (DE) Prerequisite(s): 511. Comment(s): Requires admission to the MBA program or consent MBA Program Director. Registration Permission: Prerequisite(s) or consent of Director of the MBA Program required.

513 MBA Core III (9) Continuation of the functional fundamentals from 512. Integration of value chain: supply management and resource man- agement. Capstone integrated experience using information technology. (DE) Prerequisite(s): 511 and 512. Comment(s): Requires admission to MBA program or consent of MBA Program Director.

Registration Permission: Prerequisite(s) or consent of Director of the MBA Program required.

514 Integrated Business Simulation (1) Computer simulation. Teams manage business within competitive marketplace. (DE) Prerequisite(s): 511, 512, and 513. Comment(s): Requires admission to MBA program or consent of MBA Program Director. Registration Permission: Prerequisites or consent of Director of the MBA Program required.

520 Innovation and Entrepreneurship (3) Introduces students to inno- vation and entrepreneurship business logics and strategies. Topics in- clude innovative problem solving, business consulting practices, busi- ness planning, continuous improvement, transformational change leader- ship, and project management. (DE) Corequisite(s): 513. Comment(s): Prior knowledge may satisfy prerequisite with consent of instructor.

521 Business Core for Master of Accountancy I (3) Topics in business having relevance to Master of Accountancy students. Topics vary to re- flect current needs of the accounting profession. Sequence 521-522- 523 culminates with a business simulation. Comment(s): Master of Accountancy admission required.

522 Business Core for Master of Accountancy II (3) Topics in business having relevance to Master of Accountancy students. Topics vary to re- flect current needs of the accounting profession. Sequence 521-522- 523 culminates with a business simulation. Comment(s): Master of Accountancy admission required.

523 Business Core for Master of Accountancy III (3) Topics in busi- ness having relevance to Master of Accountancy students. Topics vary to re- flect current needs of the accounting profession. Sequence 521-522- 523 culminates with a business simulation. Comment(s): Master of Accountancy admission required.


( DE) Prerequisite(s): 551.


( DE) Prerequisite(s): 552.

561 Management Project I (3) Company project. Preliminary investigation of significant strategic issue (new initiative, program or significant organizational change) to enhance organizational effectiveness in sponsoring organization. Work within firm under guidance of faculty to develop proposal which defines issue and scope of project. Proposal to be approved by company and faculty.

( DE) Corequisite: 551.

562 Management Project II (3) Company project. Continuation of 561. Diagnosis and analysis of strategic issue. Work within firm under guidance of faculty member.

( DE) Prerequisite(s): 561.

563 Management Project III (3) Company project. Continuation of 562. Completion of analysis and presentation of report to senior management in sponsoring organization. Work within firm under guidance of faculty member.

( DE) Prerequisite(s): 562.

591 International Travel (2) MBA students' international trip experience. Will familiarize students with the complexities of doing business internationally through experiential learning.

Comment(s): Requires admission to MBA program or consent of MBA Program Director.

593 Directed Independent Study (3) Cross-disciplinary topic of mutual interest to student and faculty. Grading: Satisfactory/No Credit or letter grade. Repeatability: May be repeated. Maximum 6 hours.

Comment(s): Available only by prearrangement with supervising faculty member. May require approval of Director of the MBA program.

595 Entrepreneurial Strategy Implementation (3) Student teams of 2-4 individuals work with an entrepreneur to implement business strategies. Guided by a Statement of Work, students will conduct research, analyze company data, and interact weekly with the entrepreneur to understand goals of the strategy being implemented. One student per team will serve as the project manager, and a faculty member will serve as the Client Partner lead.

( DE) Prerequisite(s): 511, 512, 513, and 520.

596 Global Business Strategies (3) The strategic challenges of globalization; globalization strategies of multi-national corporations; the circumstances in which venturing overseas makes sense, and when it may not be a wise strategy; essential strategic and organizational challenges encountered by international managers (e.g., building competitive advantage in international markets, balancing benefits of global integration against the need to respond to local differences, managing joint ventures and strategic alliances including the growing trend of offshore outsourcing). Also examines how international differences in social and legal conditions affect strategic choices.

( DE) Prerequisite(s): 513.

599 Executive-in-Residence (3) Interaction with corporate executives from wide spectrum of business disciplines and discussion of domestic and international strategic planning as applied in major corporations. Recommended Background: MBA core.

Registration Permission: Consent of instructor.

631 Independent Study (3) Repeatability: May be repeated. Maximum 6 hours.

Registration Permission: Consent of instructor.

699 Special Topics (3) Seminars that integrate content from various business functions: international business, management information systems.

Chemical Engineering (226)


467 Honors: Engineering Internship in Process Control (4) Selected students work in small groups on industrial problems in process dynamics and control. Directed by faculty and engineers from host company.

( DE) Prerequisite(s): 360 and consent of instructor.

477 Honors: Applied Process Automation Laboratory (3) Interfacing flexible batch continuous processes to automation systems. Top down analysis with bottom up implementation, hierarchical structures and object oriented concepts are used to design automation solutions including human-machine-interfaces. Workstations with modern industrial equipment, provide an interactive graphics, and visualization environment.

( DE) Prerequisite(s): 360 and consent of instructor.

483 Introduction to Reliability Engineering (3) (See Nuclear Engineering 483.)

484 Introduction to Maintainability Engineering (3) (See Nuclear Engineering 484.)

500 Thesis (1-15) Grading Restriction: P/NP only. Repeatability: May be repeated.

501 Graduate Seminar (1) Grading Restriction: Satisfactory/No Credit grading only. Repeatability: May be repeated. Maximum 20 hours.

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed.

Grading Restriction: Satisfactory/No Credit grading only. Repeatability: May be repeated. Credit Restriction: May not be used toward degree requirements.

505 Engineering Analysis (3) Formulation and solution of problems in chemical engineering and materials areas, ordinary and partial differential equations; types of ODE, PDE and solution techniques; transform methods; conformal mapping; variational methods; introduction to numerical methods. (Same as Materials Science and Engineering 505.)

507 Application of Linear Algebra in Engineering Systems (3) Fundamental concepts of linear algebra to problems in engineering systems: steady state and dynamic systems. Geometric and physical interpretations of relevant concepts: least square problems, LU, QR, and SVD decompositions of system matrix, eigenvalue problems, and similarity transformations in solving difference and differential equations; numerical stability aspects of various algorithms; application of linear algebra concepts in control and optimization studies; introduction to linear programming. Computer projects. (Same as Biomedical Engineering 507; Electrical and Computer Engineering 507; Industrial Engineering 507; Materials Science and Engineering 507; Mechanical Engineering 507.)

Comment(s): Graduate standing or consent of instructor required.

509 Multidisciplinary Project (1) (See Industrial Engineering 509.)

531 Advanced Chemical Engineering Thermodynamics (3) Phase equilibrium in ideal and non-ideal solution; composition relationship between phases, solution behavior, and application to macromolecules; introduction to microscopic approach to thermodynamics.


( DE) Prerequisite(s): 531.

541 Polymer Rheology (3) (See Materials Science and Engineering 541.)

542 Diffusive and Stagewise Mass Transfer Operations (3) Analysis of mass transfer phenomena, coupled mass transfer and reaction, mass transfer operations in packed towers and agitated vessels, membrane separations. Equilibrium stage concepts applied to mass transfer operation, emphasizing nonisothermal and multicomponent systems.

547 Transport Phenomena I (3) Unified treatment of momentum transport (fluid flow), energy transport (heat conduction, convection, and radiation), and mass transport (diffusion). Fundamental basis of transport phenomena and momentum transport: viscous, viscoelastic, and potential flows.
548 Transport Phenomena II (3) Unified treatment of momentum transport (fluid flow), energy transport (heat conduction, convection, and radiation), and mass transport (diffusion). Energy transport and mass transport in closed and flow systems, interrelationships between transport processes, and prediction of transport parameters.

551 Chemical Reactor Analysis (3) Rate models for heterogeneous reactions, properties of porous catalysts, catalyst deactivation, fluid-fluid and fluid-solid reactors.

556 Data Mining in Engineering and Manufacturing (3) (See Industrial Engineering 556.)


Comment(s): Graduate standing or consent of the instructor required.

575 Applied Microbiology and Bioengineering (3) Cross-disciplinary course combining basic concepts in microbiology, biochemistry, reaction kinetics, and biochemical and environmental engineering. Commercial processes, biodegradation/wastewater treatment, analysis of basic bioreactor systems, biosensors, and immobilization methods. (Same as Biosystems Engineering 575; Environmental Engineering 575; Microbiology 575.)

580 Technical Review and Assessment (3) Preparation of critical review of literature in area related to chemical engineering. Comment(s): Enrollment is limited to students in the non-thesis option. Registration Permission: Consent of advisor.

581 Green Engineering (3) Principles and practical aspects of the design, commercialization, and use of processes and products that are feasible and economical while minimizing the generation of pollution at the source and risk to human health and environment. (Same as Engineering Science 585; Environmental Engineering 581.)

Comment(s): Graduate standing in engineering or consent of the instructor required.

585 Process System Reliability and Safety (3) (See Nuclear Engineering 585.)

590 Special Topics in Chemical Engineering (3) Repeatability: May be repeated. Maximum 6 hours.

600 Doctoral Research and Dissertation (3-15) Grading Restriction: P/NP only. Repeatability: May be repeated.

631 Advanced Topics in Statistical Thermodynamics and Molecular Dynamics (3) Statistical thermodynamics, molecular based computer simulations, Monte Carlo and molecular dynamics calculations; applications to complex materials and energy-relevant and biological systems. (DE) Prerequisite(s): 532.

632 Nonequilibrium Thermodynamics (3) Unified treatment of nonequilibrium thermodynamics from the perspective of a general mathematical framework, applicable at all levels of system description from microscopic to macroscopic. Statistical and continuum mechanical descriptions of irreversible thermodynamic systems, with applications to complex fluids, are emphasized. (DE) Prerequisite(s): 531 and 532.

633 Multiscale Materials Modeling (3) Development of multiscale simulation strategies for engineering of advanced micro-and-nano structured materials via integration of essential information from different scales, i.e., molecular, mesoscopic and continuum. (DE) Prerequisite(s): 505, 531, and 547. Registration Permission: Consent of instructor.

647 Advanced Transport Phenomena (3) Derivation and solution of coupled mass, momentum and energy evolution equations; application to complex materials and energy-relevant and biological systems. (DE) Prerequisite(s): 547 and 548.

652 Sustainable Energy Production (3) Emerging technologies in energy capture, including photovoltaic cells and bio-based fuels and in energy production, including fuel cells. Study of fundamental mechanisms. Comparative analysis of the alternatives, including current technical barriers to commercialization. (DE) Prerequisite(s): 505.

661 Advanced Topics in Process Dynamics and Control (3) Multiloop and multivariable control, model predictive control, process identification and monitoring, plantwide control, etc. Repeatability: May be repeated. Maximum 6 hours. (DE) Prerequisite(s): 505.

662 Chaos and Engineering Applications (3) Chaos and nonlinear dynamics analysis of time series for understanding, development, design and control of complex engineering systems; systems with continuous multi-scale temporal and spatial variations; review of standard analysis techniques; applications to bubble formation, distillation, fluidization, combustion, fermentation, patterns (nonwoven fabrics, nanotubes), molecular-self organization, cardiac control, and bioinformatics. (DE) Prerequisite(s): 505. Recommended Background: Programming.

671 Advanced Biomolecular Engineering (3) Current science and technology at the interface of engineering and biology, focusing at the molecular level. Topics include enzyme-based sensors, molecular-level engineering for bio-based energy production, genetic engineering for protein expression in non-native hosts, modeling of metabolic networks and gene expression. (DE) Prerequisite(s): 575. Recommended Background: Working knowledge of undergraduate level biochemistry and cellular biology; graduate chemical engineering core coursework.

Registration Permission: Consent of instructor.

672 Computational Bioinformatics (3) Modeling and analysis of DNA/RNA and protein sequences. Topics include STR and SNP DNA measurement data for human identification; dynamic programming; distance measures, clusters, and link analysis and discovery; clustering algorithms; data mining using SVD method; dynamic indexing of data collections using clustering; probability theory; Bayesian and maximum likelihood estimation; entropy as a measure of information content and inductive inference; parallel computation. Applications to biological molecules will be studied. (DE) Prerequisite(s): Statistics 505 and 507. Recommended Background: Programming skills.

691 Advanced Topics in Chemical Engineering (3) Repeatability: May be repeated. Maximum 6 hours.

Chemistry (235)

430 Advanced Inorganic Chemistry (3) Atomic and molecular structure, bonding theories, descriptive chemistry of the elements, kinetics and mechanism of inorganic reactions, applications of modern techniques for characterization, coordination and organometallic chemistry. (DE) Prerequisite(s): 530.

450 Advanced Organic Chemistry (3) Modern organic reactions of mechanistic, synthetic, and theoretical interest. Content reflects current trends in the area. (DE) Prerequisite(s): 530.

471 Biophysical Chemistry (3) (See Biochemistry and Cellular and Molecular Biology 471.)

483 Physical Chemistry II (3) Properties of gases: first, second and third laws of thermodynamics; chemical equilibria; simple phase equilibria; properties of solutions. Credit Restriction: Students may not receive credit for both 471 and 473. (DE) Prerequisite(s): 130 or 138 and Physics 136 or 138 or 222 or 231 and Mathematics 241, 247.

479 Physical Chemistry Laboratory I (2) Experiments on topics discussed in 471 or 473. Contact Hour Distribution: 1 lab. (DE) Prerequisite(s) or (DE) Corequisite(s): 471 or 473.

481 Biophysical Chemistry (3) (See Biochemistry and Cellular and Molecular Biology 481.)

483 Physical Chemistry II (3) Introduction to statistical thermodynamics; kinetics of chemical reactions; introduction to quantum mechanics and applications to electronic structure of atoms and molecules; molecular spectroscopy. Credit Restriction: Students may not receive credit for both 481 and 483. (DE) Prerequisite(s): 130 or 138 and Physics 136 or 138 or 222 or 231 and Mathematics 241, and 247.

489 Physical Chemistry Laboratory II (2) Experiments on topics discussed in 481 or 483. Contact Hour Distribution: 1 lab. (DE) Prerequisite(s) or (DE) Corequisite(s): 481 or 483.

500 Thesis (1-15) Grading Restriction: P/NP only. Repeatability: May be repeated.

501 Chemistry Seminar (1) Lectures and discussion on current research. Continuous registration is required for resident graduate students. Grading Restriction: Satisfactory/No Credit grading only. Repeatability: May be repeated. Maximum 14 hours.
502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated. Credit Restriction: May not be used toward degree requirements.

505 Special Problems (3) Specially assigned theoretical or experimental work on problems not covered in other courses.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated. Maximum 6 hours.
Registration Permission: Consent of department.

510 Analytical Spectrometry (3) Principles and practice of optical and mass spectrometric techniques in quantitative chemical analysis.
Recommended Background: 2 semesters of physical chemistry.

511 Analytical Separations (3) Principles and practice of chemical separations based on extraction, chromatographic, and electrophoretic phenomena.
Recommended Background: 2 semesters of physical chemistry.

512 Electroanalytical Chemistry (3) Fundamentals of electrode processes; principles and practice of electroanalytical techniques in quantitative chemical analysis and applied to study of chemical systems.
Recommended Background: 2 semesters of physical chemistry.

530 Chemical Bonding (3) Wave mechanical atom, group theory, quantum approach to molecular orbital theory, covalent, ionic, and metallic bonding, ligand field theories, solid state.
Recommended Background: 1 semester of inorganic chemistry.

531 Characteristics of Inorganic Compounds (3) Descriptive chemistry of elements; structure, reactions, kinetics, mechanisms, equilibria, and spectra of coordination, organometallic, bioinorganic compounds.
Recommended Background: 1 semester of inorganic chemistry.

532 Experimental Methods of Inorganic Chemistry (3) Electronic, infrared, Raman, microwave, NMR, ESR, nuclear quadrupole, Mossbauer, mass, and photoelectron spectroscopies for characterization of inorganic compounds.
Recommended Background: 1 semester of inorganic chemistry.

533 Chemistry of the Transition Metals (3) Theoretical and experimental foundations of modern coordination, organometallic, and bio-inorganic chemistry of transition metals; transition metal mediated catalysis, materials chemistry, isobal theory, kinetics and mechanism of reactions of transition metals, and applications in organic synthesis.
Recommended Background: 1 semester of inorganic chemistry.

550 Structure and Reactivity in Organic Chemistry (3) Structure and bonding in organic compounds; molecular orbital theory, stereochemistry, conformational analysis, and molecular mechanics; substituent effects on acidity and reactivity; introduction to reaction mechanisms.
Recommended Background: 2 semesters of organic chemistry.

551 Organic Reactions (3) Organic transformations of use in synthesis; carbonyl chemistry and carbon-carbon bond formation; stereochemistry and regiochemistry of synthetic processes.
(DE) Prerequisite(s): 550.

552 Applications of Organic Reactions (3) Applications of organic reactions to directed synthesis targets including bio-organic substrates, natural products, medicinal agents, or other molecules of practical or theoretical interest.
(DE) Prerequisite(s): 550.

Recommended Background: 2 semesters of organic chemistry.

570 Quantum Chemistry and Spectroscopy (3) Basic principles of quantum mechanics and their applications to molecular orbital theory, molecular structure, and spectroscopy; introduction to group theory.
Credit Restriction: May not be used toward degree requirements.

571 Advanced Quantum Chemistry and Spectroscopy (3)
(DE) Prerequisite(s): 570 or consent of instructor.

572 Thermodynamics and Statistical Mechanics (3) Macroscopic and microscopic description of equilibrium systems. Basic principles of thermodynamics and statistical mechanics, and application to selected chemical systems.
Recommended Background: 2 semesters of physical chemistry.

573 Chemical Kinetics and Transport (3) Time-dependent phenomena in chemistry: chemical kinetics, chemical dynamics, transport theory.
Recommended Background: 2 semesters of physical chemistry.

590 Polymer Chemistry (3) Fundamentals of polymer synthesis and characterization through application of organic and physical chemical principles.
Recommended Background: 2 semesters of organic chemistry and 2 semesters of physical chemistry.

(DE) Prerequisite(s): 590 or equivalent.

595 Physical Chemistry of Polymers (3) Conformation of macromolecules, solution and bulk properties, rubber elasticity, kinetics of polymerization, polymer thermodynamics.
(DE) Prerequisite(s): 590 or equivalent.

600 Doctoral Research and Dissertation (3-15) Grading Restriction: P/NP only.
Repeatability: May be repeated.

601 Chemistry Research Proposal (2) Preparation and oral defense of original written research proposal based on thorough survey of chemical literature.
Grading Restriction: Satisfactory/No Credit grading only.
Registration Permission: Consent of department head.

610 Selected Topics in Analytical Chemistry (3) Topics of current significance.
Repeatability: May be repeated. Maximum 12 hours.
(DE) Prerequisite(s): 510, 511, and 512 or consent of instructor.

630 Selected Topics in Inorganic Chemistry (3) Topics of current significance.
Repeatability: May be repeated. Maximum 12 hours.
(DE) Prerequisite(s): 530, 531, and 532 or consent of instructor.

650 Selected Topics in Organic Chemistry (3) Topics of current significance.
Repeatability: May be repeated. Maximum 12 hours.
(DE) Prerequisite(s): Any two of 550, 551, 552 or consent of instructor.

670 Selected Topics in Physical Chemistry (3) Topics of current significance.
Repeatability: May be repeated. Maximum 12 hours.
(DE) Prerequisite(s): 570, 572, and 573 or consent of instructor.

690 Selected Topics in Polymer Chemistry (3) Topics of current significance.
Repeatability: May be repeated. Maximum 12 hours.
Registration Permission: Consent of instructor.

691 Selected Topics in Thermal Analysis of Polymeric Materials (3) Topics of current significance.
Repeatability: May be repeated. Maximum 9 hours.
Credit Restriction: Maximum 3 hours may be applied toward the chemistry major.
Registration Permission: Consent of instructor.

Child and Family Studies (245)

500 Thesis (1-15) Grading Restriction: P/NP only.
Repeatability: May be repeated.

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated. Credit Restriction: May not be used toward degree requirements.

505 Development of Interpersonal and Supervision Skills (3) Refinement of interpersonal skills needed to work with families and other professionals. Supervisory training in others' skill development, active listening, self-disclosure, relationship building, and negotiation. Skills adapted for use among family members.

510 Theory in Human Development (3) Theoretical models of human development: cognitive, social learning, and ecological theory; analysis, synthesis, and discussion of historical and contemporary relevance of models; application of theory to research, prevention, intervention, and education; critical reading and evaluation of theory-based research on human developmental processes.

511 Survey of Research in Child Development (3) Survey of human development research from conception through adolescence. Classic and contemporary empirical literature in domains of physical, cognitive, language, social, emotional, and moral development; biological basis of development; cross-cultural perspectives.
(DE) Prerequisite(s): 510 or consent of instructor.

515 Children in Contemporary Society (3) Theory and research on environmental and developmental issues in contemporary family situations and educational environments for children from infancy through middle childhood. Implications for programs and policy.

522 Naturalistic Interventions for Parents and Teachers of Young Children (3) Common problems faced by parents and teachers; methods available to modify problem behavior.

525 Seminar on Play (3) Comparison and contrast of theoretical framework and research methodologies on play. Developmental perspective on play.

530 Families of Children with Disabilities (3) Developmental nature of families’ experiences in caring for handicapped children, especially during infancy and early childhood.

Recommends Background: 6 hours of graduate coursework in child and family studies.

550 Theory and Research in Family Studies (3) Research in various major topics in family studies and application of theoretical models to understanding research.

552 Diversity in Children and Families (3) Diversity in family configurations in contemporary U.S. society. Variations of family patterns by race, ethnicity, religion, and social class; social dynamics of family formation, composition, and patterning.  
(DE) Prerequisite(s): 550.

562 Families and Children Coping with Stress (3) Processes used by children and families during times of stress. Theoretical contributions to study of impact of developmental stressors and catastrophes on children and families.  
(DE) Prerequisite(s): 550.

563 Family Life Education Programs (4) Programs in family life education, including family sexuality, family resource management, and parenthood education.  
(DE) Prerequisite(s): 550.

564 Practicum in Human Development or Family Studies I (3) School and community programs. Education for human development and family living.  
Grading Restriction: Satisfactory/No Credit grading only.  
Registration Permission: Consent of instructor.

565 Practicum in Human Development or Family Studies II (3) School and community programs concerned with education for human development and family living. Committee approved and supervised written project.  
Grading Restriction: Satisfactory/No Credit grading only.

566 Theories of Family Therapy (3) Exploration of classic and contemporary theoretical approaches in family therapy. Emphasis given to application of concepts and methods from these approaches to family situations.  
(See same as Counselor Education 566.)

567 Family Violence (3) Theory and research on initiation, maintenance and cessation of violent behaviors in intimate family contexts, and assessment of responses to violent family behaviors, perpetrators, victims, and family systems.  
(DE) Prerequisite(s): 550.

569 Action Research in Early Childhood Education (3) Principles and methodologies of action research for practitioners in early childhood and school settings.  
Comment(s): Requires admission to the early childhood education graduate concentration in the College of Education, Health, and Human Sciences.

Recommended Background: 9 graduate hours in the major.

572 Professional Socialization (2) Behaviors and practices appropriate to a professional researcher and practitioner in the field of Child and Family Studies: understanding and working within the university environment, maintaining ethical standards, complying with human subjects protocols, making public presentations, and networking with peers.

574 Analysis of Teaching for Professional Development (1-2) Strategies to document and analyze effectiveness of teaching and professional development. Study and application of various approaches.  
Repeatability: Not repeatable. May be taken once for 1-2 hours.  
(DE) Prerequisite(s): 575.

575 Professional Internship in Teaching (1-8) Intensive teaching and teaching-related experiences in professional settings in public schools. Enrollment limited to post-baccalaureate students in professional year program.  
Grading Restriction: Satisfactory/No Credit grading only.  
Repeatability: May be repeated. Maximum 12 hours.  
Comment(s): Requires admission to the teacher education program.

580 Special Topics in Child and Family Studies (1-3) Research, theory and current issues in child development, family studies, or early learning. Topics vary.  
Repeatability: May be repeated if topic differs. Maximum 9 hours.  
Credit Restriction: Maximum 3 hours may be applied to child and family studies specialization electives for the master’s degree.  
Recommended Background: 6 graduate hours in the major or consent of instructor.

581 Directed Study in Child and Family Studies (1-3) Individual learning experiences in specific topics in child development, family studies, or early learning.  
Repeatability: May be repeated if topic differs. Maximum 6 hours.  
Credit Restriction: May not be applied to child and family studies specialization electives for the master’s degree.  
Recommended Background: 6 graduate hours or consent of instructor.

591 Clinical Studies (1-4) Group and individual seminar activities during full-time internship. Application and evaluation of professional core competencies. Completion and presentation of portfolio and analysis of teaching project.  
Repeatability: Not repeatable. May be taken once for 1-4 hours.  
(DE) Corequisite(s): 575.

600 Doctoral Research and Dissertation (3-15)  
Grading Restriction: P/NP only.  
Repeatability: May be repeated.  
610 Advanced Special Topics in Child and Family Studies (1-3) Advanced, in-depth study in child development, family studies, or early learning. Topics vary.  
Repeatability: May be repeated if topic differs. Maximum 6 hours.  
Credit Restriction: Maximum 3 hours may be applied to child and family studies specialization electives for the master’s degree.  
Recommended Background: 12 graduate hours in the major or consent of instructor.

620 Advanced Directed Study in Child and Family Studies (1-3) Advanced, in-depth individualized learning experiences in specific topics in family studies, child development, or early learning.  
Credit Restriction: May not be applied to child and family studies specialization electives for the master’s degree.

631 Adolescent Development in Families (3) Normative and non-normative adolescent development: physical, cognitive, moral, social, familial, sexual, and personality.  
(DE) Prerequisite(s): 510, 511, and 550.

633 Survey Design and Analysis (3) (See Sociology 633.)

640 Seminar in Child Development, Family Studies, and Early Learning (3) Recent theoretical and empirical developments in the field. Topics vary.  
Repeatability: May be repeated if topic differs. Maximum 9 hours.  
(DE) Prerequisites: 510, 511, 550 and 570.  
Registration Permission: Consent of instructor.

650 Advanced Qualitative Research in Human Sciences (3) Methods of qualitative research are explored including narrative, phenomenological, ethnographic, grounded theory, and case study approaches. Emphasis on utilizing and analyzing data from in-depth interviews. Development of a proposed study and pilot data collection and analyses are required.  
Comment(s): For master’s students completing the certificate in qualitative analysis and for doctoral students with consent of instructor.

Recommended Background: 9 hours of graduate family studies coursework.

Recommended Background: 9 hours of graduate family studies coursework.

660 Experimental Design and Observation Methods (3) Experimental and quasi-experimental designs (group and time-series single-case) in natural and contrived settings as used in child and family research; observation methods used with these designs.  
(DE) Prerequisite(s): 570.
680 Knox Area Family and Child Study (KAFCAS) Research Practice I (3) Faculty-directed collaborative original research, including problem definition, instrumentation, data collection, data analysis, and report writing on a panel or sample of families and children in the Knox County area.
(DE) Prerequisite(s): 570.

681 Knox Area Family and Child Study (KAFCAS) Research Practice II (3) Faculty-directed collaborative original research, including problem definition, instrumentation, data collection, data analysis, and report writing on a panel or sample of families and children in the Knox County area.
(DE) Prerequisite(s): 570.

Chinese (249)

431 Readings in Chinese Literature (3) (See Asian Languages 431.)

Cinema Studies (251)

400 Special Topics (3)
Repeatability: May be repeated. Maximum 6 hours.

420 French Cinema (3) (See French 420.)

422 Topics in Italian Cinema (3) (See Italian 422.)

433 History of Film and Modern Art (3) (See Art Media Arts 433.)

434 Hispanic Culture Through Film (3) (See Spanish 434.)

435 Cinematography as Art (4) (See Art Media Arts 435.)

436 Video Art (4) (See Art Media Arts 436.)

465 Latin American Film and Culture (3) (See Spanish 465.)

469 Sexuality and Cinema (3) (See Women’s Studies 469.)

482 Special Topics in Global Cinema (3) (See Modern Foreign Languages and Literatures 482.)

489 Special Topics in Film (3) (See English 489.)

510 Special Topics (3)
Repeatability: May be repeated. Maximum 6 hours.

582 Special Topics in Global Cinema (3) (See Modern Foreign Languages and Literatures 582.)

Civil Engineering (254)

416 Hydrology (3) (See Biosystems Engineering 416.)

451 Highway Engineering (3) Design, construction, operation, and maintenance of highway facilities; includes application of various engineering principles and techniques to process of planning, locating and design of highway facilities. Covers both geometric and pavement design.
(DE) Prerequisite(s): 352.

453 Airport/Railroad Planning and Design (3) Airport master planning and railroad engineering. Runway configuration, airfield capacity, geometric, and terminal layout and design. Railroad capacity, geometric, and system layout and design.
(DE) Prerequisite(s): 352.

472 Steel Design (3) Design of plate girders and composite beams. Consideration of members subjected to combined stresses. Design of a typical framed building including connections.
(DE) Prerequisite(s): 471.

474 Reinforced Concrete Design (3) Design of continuous beams, floor slabs, columns with combined axial loads and bending, and footings. Design for torsion.
(DE) Prerequisite(s): 471.

485 Principles of Hydrogeology (3) (See Geology 485.)

490 Water Resources Engineering (3) Application of hydrologic/hydraulic principles for development of water resource project design and management of water resources. Assessment of environmental impacts to surface water and groundwater. Regulatory framework for water supply and water quality.
(DE) Prerequisite(s): 390 and 395 or 416.

500 Thesis (1-15)
Grading Restriction: P/NP only.
Repeatability: May be repeated.

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated.
Credit Restriction: May not be used toward degree requirements.

510 Urban Systems: Engineering and Management (3) Various urban systems usually under responsibility of city manager and/or city engineer: streets, lighting, water, sewerage, refuse collection. Personnel management, finance, planning and public relations.
Comment(s): Graduate standing or consent of instructor required.

521 Pavement Design (3) Empirical and theoretical based methods of pavement design and analysis, strengthening existing pavements, pavement distress and economical design alternatives.
(DE) Prerequisite(s): 321 and 330.

522 Mix Design for Asphaltic and Portland-Cement Concrete (3) Aggregate properties and tests, asphalt binder properties and tests, mix design methods for asphaltic mixtures, hot-mix asphalt (HMA) mixture production and construction, Portland-cement concrete (PCC) mix design, additives and admixtures for PCC, special types of PCC, PCC production and construction.
(DE) Prerequisite(s): 321.

525 Pavement Materials Characterization (3) Material modeling, laboratory and in-situ characterization of unbound granular, stabilized base, hot-mix asphalt mixtures, Portland cement concrete, and other paving materials; performance prediction for flexible and rigid pavements.
(DE) Prerequisite(s): 321 and 330.

(DE) Prerequisite(s): 330.

531 Soil Stabilization (3) Mechanical stabilization of soils by compaction, drainage, and blending; chemical stabilization of soils with admixtures, waterproofing and modifying soils and additives. Reinforced earth and stabilization with geosynthetics.
(DE) Prerequisite(s): 330.

532 Rock Mechanics and Rock Engineering (3) Engineering properties and characterization of rock and rock masses. Discontinuity analysis, stress and strain, keyblock theory. Applications to rock slopes, underground excavations, foundations and groundwater flow.
(DE) Prerequisite(s): 330 or consent of instructor.

533 Advanced Laboratory and In situ Testing of Soil (3) Instruments for measurement of electrical signals, static and dynamic transducers, data acquisition and control, in situ measurement of stress, pore pressure, deformation, load deformation behavior (seismic methods, static methods), advanced laboratory shear strength and compressibility testing.
Contact Hour Distribution: 2 hours and 1 lab.
(DE) Prerequisite(s): 330.

(DE) Prerequisite(s): 345.

538 Finite Element Applications in Geotechnical Engineering (3) Application of finite element method to typical problems in geotechnical engineering. Confined and unconfined flow through porous media; two-dimensional stress and strain; two-dimensional elements; representation of nonlinear soil behavior with elastic and elastic-plastic models. Taught concurrently with 561.
Credit Restriction: Students may not receive credit for both 538 and 561. Recommended Background: Coursework in soil behavior and matrix computation.

539 Geotechnology Seminar (1) Seminar topics in geotechnical and geological engineering. Research contributions and case histories by graduate students and engineers and scientists from surrounding community.
Grading Restriction: Satisfactory/No Credit grading only.
Repeatability: May be repeated. Maximum 10 hours.
Comment(s): Enrollment limited to students with graduate standing.
Registration Permission: Consent of advisor.

540 Construction Management I (3) Management and organization of heavy and building construction projects.
(DE) Prerequisite(s): 442.

541 Construction Management II (3) Management organization of heavy and building construction projects.
(DE) Prerequisite(s): 442.

543 Construction Estimating (3) Project costs, estimating and takeoff techniques, market cost conditions, and feasibility of design to cost.
(DE) Prerequisite(s): 442.