Graduation requires passing a comprehensive examination, taken no later than the end of the second year, completion of all course requirements with a minimum 9.0 GPA, completion of the language requirement, and successful oral defense of the dissertation.

The comprehensive examination includes both written and oral parts in which the candidate will be tested on his/her knowledge of the area concerning the proposed dissertation and of related fields. The candidate is expected to be conversant in a wide field of geological sciences.

A minimum of 24 hours of graded coursework beyond the master's degree is required in addition to the 24 hours of Dissertation 600. The coursework includes the sum of 9 hours of 600-level geology courses, 9 hours of 500-level or higher geology courses, and 6 hours of additional graduate courses. Extra-departmental coursework is encouraged.

The student must demonstrate a reading knowledge of a foreign language in which there is a body of geological literature, as approved by the student's dissertation committee.

**GRADUATE COURSES**

401 Quantitative Methods in Geology (3) Application of calculus and differential equations to problems in earth sciences. Examples of diffusion equation in hydrogeologic wave equation in geophysics; mechanical modeling and boundary conditions in structural geology and tectonics. Prereq: The Dynamic Earth or Earth, Life, and Time. 2 semesters of Calculus.

410 Advanced Mineralogy (3) Crystal chemistry of rock-forming minerals. Interaction of electromagnetic radiation and crystalline solids. Optical properties of minerals; visible and infrared spectroscopy, and x-ray diffraction. Laboratory exercises emphasize thin section and x-ray diffractometer methods of mineralogy. Prereq: 310. 2 hrs and 1 lab.

420 Paleogeology (4) Principles of ecological analysis as applied to fossils and fossil assemblages; data collection and interpretation. Laboratory designed around preparation of scientific reports based on field and laboratory analysis. Writing emphasis course. 3 hrs and 1 lab.

421 Invertibrate Paleontology (4) Survey of invertebrate animal phylogeny, skeletal structure and preservation, functional morphology, ecology, and stratigraphic distribution. Prereq: Paleobiology or consent of instructor. 2 hrs and 2-2.5 labs.

440 Field Geology (6) Summer field course for advanced undergraduate and graduate students in geology. Taught off-campus and requires full time of student. Synthesis of major aspects of geological sciences in societal context. Field techniques demonstrated, practiced, and applied to solution of geologic problems. Prereq: Completion of major core courses and consent of instructor.

450 Process Geomorphology (3) Integrative approach to development of surface of earth based upon case histories, maps, remote sensing imagery. Prereq: 101-02. (Same as Geography 450.) 2 hrs and 1-2 hr lab.

454 Basic Environmental Geology (3) Applications of geological sciences toward comprehension of effects of geological processes on human activities on earth's environments. Prereq: 12 hrs of geology courses. 2 hrs and 1-3 hr lab or field period.

460 Principles of Geochemistry (3) Application of chemical principles to geologic problems. Crystal chemistry and relation between basic atomic structure and distribution and behavior of elements in earth's crust. Prereq: Chemistry 120-30. Recommend prereq: 330. 2 hrs and 1 lab.


471 Fieldwork in Geophysics (2) Geophysical investigations applied to solution of problems in tectonics, hydrogeology, or environment. Summer field course off-campus. Requires full time for 2 or more weeks. Prereq: 470 or consent of instructor.

475 Physical and Chemical Systems of the Earth (3) Development of physical earth from solar nebula to present. Formation, composition and evolution of hydrosphere, crust, mantle, and core. Interdependence of geology, volcanism, plate tectonics, geomagnetism, and chemical and isotopic processes of interior, and earth's temperature. Historical perspective on major controversies and problems of earth history. Prereq: 10 hrs of geology courses numbered 300 and above. 2 hrs and 1 discussion.

480 Principles of Economic Geology (4) Ore-forming processes, classification of mineral deposits, survey of different types of mineral deposits with examples, and metallogeneis. Prereq: 310 and 330 or equivalents. Recommended prereq: 460. 1 hrs and 2-1 hr lab.

485 Principles of Geohydrology (3) Ground water flow, aquifer analysis, ground water contamination, and ground water management. Prereq: General Geology or equivalent or consent of instructor. General Chemistry or equivalent, and Calculus or equivalent. (Same as Civil Engineering 485.)

500 Thesis (1-15) P/N only. E

502 Registration for Use of Facilities (3-15) Required for the student: not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/N only. E

505 Structure of the Southern and Central Appalachians (2) Structural development of Southern and Central Appalachians from extensional Late Proterozoic—Early Paleozoic rift-platform margin through processes related to compressional events producing accretionary elements that formed Appalachians throughout the Paleozoic. Comparisons to similar orogens. Prereq: Structural Geology.

510 Clay Mineralogy (3) Origin, chemistry, structures, and properties of clay minerals; application of mineralogical techniques in clay mineral studies. Prereq: 310 and 568 or equivalent. 2 hrs and 1 lab.

521 Data Analysis in Geology and Environmental Science (3) Application of statistical and other quantitative techniques using computers to analyze geological data: environmental problems.

525 Biostratigraphy (3) Examination of principles of stratigraphy and biostratigraphy through selected case histories. 1 hr and 1-2 hr seminar.

530 Petrogenesis of Crystalline Rocks (4) Origin and properties of igneous and metamorphic rocks, magmatic and subsolidus processes and physical conditions. Laboratory involves petrographic study of crystalline rocks in thin section, identification. Prereq: 10 hrs. 3 hrs and 1 lab.

534 Geological Engineering (3) (Same as Civil Engineering 534.)

535 Ground Water Hydrology (3) (Same as Environmental Engineering 535.)

540 Seminar in Local Geology (1) Introduction of geology of Southern Appalachians. 1 hr plus fieldtrips.

545 Sandstone Petrology/Physical Sedimentology (4) Field and microscopic analysis of terrigenous clastic rocks and processes of sedimentation, transport of sediment, and formation of sedimentary structures. Prereq: 340 or equivalent. 3 hrs and 1 lab.

546 Carbonate Sedimentology (4) Environments of deposition of modern and ancient carbonate sediments and diagenesis of resultant rocks; field and laboratory analysis of sample material and preparation of scientific reports. 3 hrs and 1 lab.

550 Regional Geomorphology (3) Integrative approach to study of natural geomorphological regions using integrated physical and biological processes of erosion, deposition, and formation of sedimentary structures. May be repeated with consent of instructor. 6 hrs. (Same as Geography 550.)

556 Quaternary Geology of North America (3) Interpretation of geomorphic, glacial, and sedimentologic evidence in order to reconstruct Quaternary landscapes in glaciated, periglacial, and nonglacial regions of North America; correlation of major episodes of North...
American glacial with paleo-geographic changes in
Atlantic and Pacific Oceans. Prereq: 101 or consent of
instructor.

557 Quaternary Paleoclimatology (3) Perturbation, proc-
ess, and pattern within Quaternary ecosystems; climatic change and
vegetational responses during last 2.5 mil-
lon years. Prereq: 485 or consent of instructor.

561 Aqueous Geochemistry (4) Introduction to and
applications of equilibrium thermodynamics to earth
surface environments; geochemistry of natural water,
weathering reactions, and early sediment diagenesis. Prereq: 310 or
Chemistry 120-30, 3 hrs and 1 lab or seminar.

563 Stable Isotope Geochemistry (3) Theoretical as-
pects of isotope fractionation and applications to geo-
logic systems. Isotope exchange, variations in natural waters,
diagnostic, hydrothermal and metamorphic sys-
tems. Prereq: General Chemistry or equivalent.

565 Chemical Petrology (3) Application of ther-
odynamics to geologic materials. Thermodynamics of
condensed phases, solutions, thermodynamic stability,
and behavior of multiple component phase equilibria, and
conduction of heat in earth systems. Prereq: Chem-
istry 120-30, Mathematics 141-42. Recommended prereq: Physical
Chemistry.

568 Geochemical Analysis (3) Collection and treat-
ment of geochemical data using electron microprobe, x-
ray fluorescence, and atomic absorption spectrophotom-
etry techniques. Prereq: 310 or consent of instructor. 2 hrs
and 1 lab.

570 Advanced Structural Geology (4) Current topics in
structural geology and tectonics of mountain belts; re-
cent literature. Prereq: 370 or equivalent, or consent of
instructor. 3 hrs and 1 lab or seminar.

571 Regional Tectonics and Structural Geology (3)
Major subdivisions of earth's crust and processes that
form them. Comparison of internal structure of mountain
chains and how they function in increasing continental
crust. Examples from different parts of world. Prereq:
Structural geology or consent of instructor.

572 Fracture Analysis (3) Field and subsurface charac-
terization, and mechanical development of natural frac-
tures: role in groundwater flow. Prereq: Structural Ge-
ology or equivalent, or consent of instructor.

575 Plate Tectonics and Orogeny (4) Tectonic de-
velopment of orogenic belts in context of newest aspects of
plate tectonics; current literature and ongoing research
for both modern and ancient examples. Prereq: 370 or consent of
instructor. 3 hrs and 1 seminar.

576 Reflection Seismology (3) Imaging: subsurface fea-
tures using reflected seismic waves. Energy sources,
modes of wave propagation, field procedures, computer
data processing, and pitfalls. Applications to tectonic and
environmental problems. Prereq: 470 or consent of
instructor.

585 Contaminant Hydrogeology (3) Physical trans-
port processes, contaminants and groundwater age dating,
processes influencing inorganic, organic and microbial
contaminants, sampling and monitoring methods, reme-
diation of contaminated groundwater. Prereq: 485 or 535; 460 or 561;
or Environmental Engineering 553 or equivalent; and
consent of instructor.

586 Field and Laboratory Methods in Hydrogeology
(2) Laboratory research methods. Measurement of hydric pro-
erties, drilling, sampling and instrumentation, tracer ex-
periments. Formulating hypothesis and research plans.
Prereq or coreq: 485 or 535, 585, and consent of instruc-
tor.

590 Special Problems in Geology (1-3) Directed study or
special topics. Prereq: Internal structure of mountain
chains. May be repeated. Maximum 10 hrs.

591 Foreign Study (1-15) See College of Arts and
Sciences.

592 Off-Campus Study (1-15) See College of Arts
and Sciences.

593 Independent Study (1-15) See College of Arts
and Sciences.

594 Field Problems in Geology (1-2) Literature study
and seminars on specific regions of geologic interest,
supplemented by general or directed field trip. Prereq: Consent
of instructor. May be repeated. Maximum 8 hrs.

595 Selected Topics in Geology (1) Presentation of
graduate, faculty, and visiting scientist research. Regis-

Germanc and Slavic Languages

(College of Arts and Sciences)

MAJORS

German.................... M.A. Modern Foreign Languages .............. Ph.D.

David E. Lee, Head

Professors:
Falen, James E. (Emeritus), Ph.D. Pennsylvania
Wiehe, Donald M. (Emeritus), Ph.D. ..... Indiana
Kratz, Henry (Emeritus), Ph.D. .... Ohio State
Osborne, J.C. (Emeritus), Ph.D. Northern Illinois

Associate Professors:
Hodges, Carolyn R., Ph.D. Chicago
Laudenbach, Nancy A. (Liaison), Ph.D. Wisconsin
Lee, David E., Ph.D. Stanford
Meller, C. J., Ph.D. Chicago

Assistant Professors:
Hoeyng, Peter, Ph.D. Washington
Moser, Beverly, Ph.D. Georgetown
Ohsneng, Stefanie, Ph.D. McGill
Pervukhin, Natalia K., Ph.D. Bryn Mawr

The Department of Germanic and Slavic Languages offers two advanced degrees: the
Master of Arts in German and the Doctor of Philosophy in Modern Foreign Languages.
Inquiries should be addressed to the head of the department.

THE MASTER'S PROGRAM

The department requires a minimum of 30
semester hours including 15 hours of course-
work numbered 500 and above and 6 hours of
Thesis 500.

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

610 Seminar in Paleontology (3) May be repeated with
consent of department. Maximum 6 hrs.

620 Seminar in Petrology (3) May be repeated with
consent of department. Maximum 6 hrs.

630 Seminar in Sedimentary Geology (3) May be repeated with
consent of department. Maximum 9 hrs.

640 Seminar in Geomorphology and Quaternary
Geology (3) May be repeated with consent of depart-
ment. Maximum 9 hrs.

650 Seminar in Geoscience and Quaternary
Geology (3) May be repeated with consent of depart-
ment. Maximum 9 hrs.

670 Seminar in Structural Geology (3) May be repeated with
consent of department. Maximum 9 hrs.

675 Seminar in Geophysics (3) Advanced treatment of
selected topics in geophysics. Prereq: 470 or consent of
instructor.

680 Seminar in Economic Geology (3) May be repeated with consent of department. Maximum 9 hrs.

THE DOCTORAL PROGRAM

The Ph.D. in Modern Foreign Languages is
offered jointly by the Department of Germanic
and Slavic Languages and the Department of
Romance and Asian Languages and requires
advanced training in at least two foreign
languages.

Admission Requirements

Applicants must have completed a B.A. in
either French, German or Spanish to be
accepted into this program. Both graduates
of institutions in the United States and those
with undergraduate degrees from institutions outside
the United States must have a grade point
average of at least 3.0. Consideration will also be
given to applicants who do not have an
undergraduate degree in one of the three foreign
languages but do have the equivalent of
an undergraduate major in one of them.

Degree Requirements

Candidates must complete a minimum of 63
semester hours of course work beyond the
Bachelor's degree in addition to 21 hours
doctoral research and dissertation. Two tracks
are available.

The coursework for Track I must be
distributed as follows: (1) at least 39 hours in
the first concentration; (2) at least 18 hours in
the second concentration; and (3) at least 6 hours in
a cognate field.

1. First Concentration: French, German, or
Spanish. It consists of a minimum of 39
semester hours beyond the Bachelor's degree,
distributed as follows:
- A minimum of 21 hours at the 500 level
(exclusive of thesis hours) including French 584
(3), German 560 (3), or Spanish 550 (3).
- At least 12 hours of the 600 level (exclusive of
dissertation hours).

2. Second Concentration: French, German,
Italian, Russian, or Spanish (different from the
first concentration). It consists of at least 18
semester hours of courses beyond the Bachelor's degree,
at least 12 of which must be at the 500 or 600
level.

3. Cognate Field: Six hours must be in
graduate courses numbered 400 and above in a
field outside the department of the first
concentration but related to the student's
principal area of research. If the cognate field is
yet a third foreign language, a reading profi-
ciency exam will be administered after
completion of the 6 cognate hours by the
language section concerned.

The coursework for Track II must be
distributed as follows: (1) at least 45 hours in
the first concentration; (2) at least 12 hours in
the second concentration; and (3) at least 6 hours in
a cognate field.

1. First Concentration: French or Spanish. It
consists of 45 semester hours beyond the
bachelor's degree, distributed as follows:
- A maximum of 6 hours of 400-level classes taken for the M.A. may be applied.
- A minimum of 21 hours at the 500 level
(exclusive of thesis hours) including French 584
(3), German 560 (3), or Spanish 550 (3).
- At least 12 hours at the 600 level
(exclusive of dissertation hours).

2. Second Concentration: French, German,
Italian, Russian, or Spanish (different from the
first concentration). It consists of at least 18
semester hours of courses beyond the Bachelor's degree,
at least 12 of which must be at the 500 or 600
level.

3. Cognate Field: Six hours must be in
graduate courses numbered 400 and above in a
field outside the department of the first
concentration but related to the student's
principal area of research. If the cognate field is
yet a third foreign language, a reading profi-
ciency exam will be administered after
completion of the 6 cognate hours by the
language section concerned.

A minimum of 45 hours in the first
concentration; (2) at least 12 hours in
the second concentration; and (3) at least 6 hours in
a cognate field.

1. First Concentration: French or Spanish. It
consists of 45 semester hours beyond the
bachelor's degree, distributed as follows:
- A maximum of 6 hours of 400-level classes
taken for the M.A. may be applied.
- A minimum of 27 hours at the 500 level
(exclusive of thesis hours) including French 584
(3) or Spanish 550 (3); French 512 (3) or
Spanish 512 (3); and French 516 (2) or
the appropriate Spanish course.
- At least 12 hours at the 600 level
(exclusive of dissertation hours).
2. Second Concentration: French, German, Italian, Portuguese, Russian, or Spanish (different from the first concentration). It consists of at least 12 hours, with a minimum of 3 hours at the 500 level. Students are encouraged to take classes that complement the primary area of expertise in the first concentration, so that this second concentration will be a useful research tool for the dissertation and future professional activities. (Because Track II students will have taken 12 graduate hours instead of 18 hours in the second concentration, they will normally not be eligible to teach that language at institutions which follow SACS guidelines for college foreign language teaching.)

3. Cognate Field: Six hours must be in courses numbered 400 and above in a field outside the candidate's first concentration but related to the student's principal area of research. If the cognate field is yet a third foreign language, a reading proficiency exam will be administered after completion of the 6 cognate hours by the language section concerned.

4. Additional requirements for both tracks: A student must demonstrate competence in the languages of both the first and second concentrations by taking a test in each language. The test will include reading, writing, listening, and speaking, and should be completed by the time the student reaches 40 hours of study beyond the bachelor's degree.

Standardized examinations that may be used for this purpose include applicable portions of either the National Teachers Examination, the MLAT Examination for Teachers and Advanced Students, or the proficiency standards of the United States Foreign Service Institute (FSI).

If the student has not chosen a third language as his or her cognate area, basic competence (determined by a reading examination with translation into English administered by the department concerned) in a third language is required. If the student's first and second languages are Romance languages, the third language should be chosen from another language family.

A comprehensive examination on the language and literature of the first and second concentrations must be passed before the student may be admitted to candidacy. The candidate is required to defend his/her dissertation in an oral examination. Central emphasis is put on the doctoral dissertation as a final test of the candidate's scholarly qualifications.

Graduate Teaching Assistants in the program should have the opportunity and will be strongly encouraged to instruct at least two foreign language sections subject to staffing needs.

Doctoral students are strongly encouraged to reside and study abroad and will be assisted in identifying potential sources of financial support (e.g., Fulbright, McClure, Rotary fellowships).

For additional courses, see Romance and Asian Languages.

**ACADEMIC COMMON MARKET**

An agreement among southern states for sharing graduate programs allows legal residents of some states to enroll in certain programs at UT Knoxville on an in-state tuition basis. The Ph.D. program in Modern Foreign Languages is available to residents of the state of Alabama. Additional information may be obtained from the Admissions Specialist in the Office of Graduate Admissions and Records.

---

### German

**GRADUATE COURSES**

331-32 Elements of German for Upper-Division and Graduate Students (3,3) Elements of language, elementary and advanced readings, and a final 10,000 word translation project. Open to graduate students preparing for language examinations, and upper division students desiring reading knowledge of the language. No credit for students having completed 101-102 or 107. 332 may be repeated. Maximum 8 hrs. Undergraduate credit only.

411-12 Advanced Conversation and Composition (3,3) Prereq: 311-12 or equivalent or consent of department.

420 Selected Topics in German Literature from 1750 to 1800 (3) Prereq: 6 hrs of 300-level courses (excluding 331-32 and courses in English translation) or equivalent.

421 German Lyric Poetry (3) Prereq: 6 hrs of 300-level courses (excluding 331-32 and courses in English translation) or equivalent.

422 German Drama (3) Prereq: 6 hrs of 300-level courses (excluding 331-32 and courses in English translation) or equivalent.

423 German Narrative Prose (3) Prereq: 6 hrs of 300-level courses (excluding 331-32 and courses in English translation) or equivalent.

424 German Literary Movements (3) Survey of major periods in development of German literature since 1750: problems and pitfalls of periodization.

425 Introduction to Descriptive Linguistics (3) (Same as French 426, Spanish 426, Linguistics 425, and Russian 425.)

426 Methods of Historical Linguistics (3) Phonetics, distinctive feature analysis, sound change types, nature of sound change, principles of reconstruction, and fundamental assumptions about language change through time. Survey of non-phonological linguistic change, language families, Proto-Indo-European, and other proto languages. Prereq: 6 hrs of upper division foreign language courses (excluding courses in translation or graduate reading courses). (Same as Russian 426, French 426, Spanish 426, and Linguistics 426.)

435 Structure of the German Language (3) Contrastive English-German segmental and suprasegmental phonemes, contrastive English-German linguistic structures, selected topics in advanced German grammar and syntactic analysis. Prereq: 6 hrs of upper division German language courses (excluding courses in translation or graduate reading courses). (Same as Linguistics 435.)

436 History of the German Language (3) Development of German language from Indo-European through Proto-Germanic, Old High German, Middle High German to New High German. Internal and external linguistic history of German speech. Prereq: 6 hrs of upper division German language courses (excluding courses in translation or graduate reading courses). (Same as Linguistics 436.)

485 Business German (3) Survey of German used in fields of business, government, administration, and economics. Prereq: 6 hrs of upper division German excluding courses in translation and graduate courses.

500 Thesis (1-15) P/NP only. E

502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/N only. E

510 German Phonetics and Advanced Grammar (3) Advanced work in phonetics, pronunciation, and selected topics in German grammar. For teachers and prospective teachers. Prereq: Consent of instructor.

512 Teaching a Foreign Language (3) Practical application of methods of teaching and evaluating basic language skills and foreign language skills, and cultural knowledge through seminars, demonstrations, peer teaching, and observation of foreign language classes. Required of all M.A. and Ph.D. students holding GTAs, except those whose previous training or experience warrants excuse by department.

519 Bibliographical Methods (1) Bibliographical methods, major reference works and bibliographical problems in language and literature.

520 Prossemario (2) Advanced training in use of bibliographical and reference tools; illustrative problems; paper preparation.

541-42 Medieval German Literature and Language (3,3) 541 -- Introduction to Middle High German. 542 -- Readings in Medieval German Literature.

550 Studies in German Literature (3) Content varies. May be repeated. Maximum 6 hrs.

551 German Humanism, Reformation and Baroque (3) Content varies. May be repeated. Maximum 6 hrs.

552 German Enlightenment, Rococo, and Sturm und Drang (5) Content varies. May be repeated. Maximum 6 hrs.

553 German Classicism and Romanticism (3) Content varies. May be repeated. Maximum 6 hrs.

554 German Realism and Naturalism (3) Content varies. May be repeated. Maximum 6 hrs.

555 Modern German Literature 1890-1945 (3) Content varies. May be repeated. Maximum 6 hrs.

556 Modern German Literature 1945-Present (3) Content varies. May be repeated. Maximum 6 hrs.

557-72 Directed Readings in German Language and Literature (3,3)

591 Foreign Study (1-15) See College of Arts and Sciences.

592 Off-Campus Study (1-15) See College of Arts and Sciences.

593 Independent Study (1-15) See College of Arts and Sciences. Letter grade or S/N.

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

610 Gothic (3) Phonology, morphology, and syntax of Gothic language. Relationship to Indo-European languages and other Germanic languages. Readings from Gothic Bible.

611 Old High German (3) Phonology, morphology, and syntax of Old High German. Representative readings.

621-22 Seminar in German Literature (3,3) May be repeated. Maximum 18 hrs.

631-32 Seminar in German and Germanic Philology (3,3)

---

### Russian

**GRADUATE COURSES**

401-02 Advanced Grammar, Conversation, and Composition (3,3) Prereq: Russian Composition and Conversation or equivalent.

425 Introduction to Descriptive Linguistics (3) (Same as French 425, German 425, Spanish 425, and Linguistics 425.)

426 Methods of Historical Linguistics (3) (Same as French 425, German 425, Spanish 425, and Linguistics 426.)

451-52 Senior Seminar (3,3) For majors in Russian; minors admitted at the discretion of the instructor. Intensive study of language, literary style, and literary criticism based on selected major novels.

510 Russian Phonetics and Advanced Grammar (3) Phonetics, pronunciation, stylistics, and selected topics in Russian grammar. For teachers and prospective teachers. Prereq: Consent of instructor.
Health, Leisure, and Safety Sciences

(College of Human Ecology)

MAJORS

<table>
<thead>
<tr>
<th>Human Ecology</th>
<th>Ph.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Education</td>
<td>Ed.D.</td>
</tr>
<tr>
<td>Health Promotion and Health Education</td>
<td>M.S.</td>
</tr>
<tr>
<td>Public Health</td>
<td>Ph.D.</td>
</tr>
<tr>
<td>Recreation and Leisure Studies</td>
<td>M.S.</td>
</tr>
<tr>
<td>Safety Education and Service</td>
<td>M.S., Ed.D.</td>
</tr>
</tbody>
</table>

Charles B. Hamilton, Head

Professors:

- Gorski, June, Dr.P.H. UCLA
- Hamilton, Charles B. (Liaison), Dr.P.H. Oklahoma
- Haynes, Gene E. (Liaison), Ph.D. North Texas State
- Kirk, Robert H., H.S.D. Indiana
- Wallace, Bill C. (Liaison), Ed.D. Northern Colorado

Associate Professors:

- Blanton, Mary Dale, Re.D. Indiana
- Kirk, Ken L., Re.D. Indiana
- Pursley, R. Jack, Ph.D. Iowa

Assistant Professors:

- Blackmon, James T., Ed.D. Tennessee
- Ellison, Jack S. (Liaison), Ed.D. Tennessee

The Health, Leisure, and Safety Sciences Department offers graduate programs leading to the Master of Science with majors in Health Promotion and Health Education, Recreation and Leisure Studies, and Safety Education and Service, and to the Master of Public Health degree in Public Health. The department provides doctoral preparation in Health Education (Ed.D. and Ph.D.) through a concentration in Health Education and course experiences leading to the Educational Specialist degree in Safety Education and Service. Inquiries should be directed to the department head. Application packets are available by request to the department. The department fosters a natural uniting of disciplines that contribute to a holistic approach to healthy living and the enjoyment of life for all citizens. The academic disciplines focus on assisting students, clients, and faculty to (1) develop a healthful and safe lifestyle that considers the dimensions of disease and injury prevention, and the role of leisure as it contributes to mental, social, and physical health; and (2) prepare persons for competent practice of their respective disciplines, including scholarly, creative, and management endeavors. The department is committed to the educational value of community-based experiential learning.

Health

Graduate programs are available leading to the Master of Science with a major in Health Promotion and Health Education (thesis and non-thesis options) and to the Doctor of Education with a major in Health Education. The Master of Science, with thesis and non-thesis options, requires completion of 30 semester hours. The Doctor of Philosophy with a major in Human Ecology offers a concentration in health education.

ACADEMIC COMMON MARKET

An agreement among southern states for sharing graduate programs allows legal residents of some states to enroll in certain programs at UT Knoxville on an in-state tuition basis. The Ed.D. program in Health Education is available to resident states of Kentucky or West Virginia. Additional information may be obtained from the Admissions Specialist in the Office of Graduate Admissions and Records.

GRADUATE COURSES

400 Consumer Health (3) Survey of major consumer health care providers and health care services; selecting, purchasing, evaluating and financing medical and health care services/products. (Same as Public Health 400.) Sp

405 Alcoholism and Alcohol Education (3) Problems of alcoholism. Factors which make alcoholism serious. Health and safety problem. Various types of instructional/educational and intervention programs. F

406 Death, Dying and Bereavement (3) Aspects of dying, death and handling trauma of loss. Medical, financial, physical, legal and social implications of death. F, Sp

420 Sex Education and Human Sexuality (3) Advancement of knowledge and understanding of human sexuality. Trends, issues, and content of human sexuality. E

425 Women's Health (3) Influencing women's health and women consumers in nation's health services delivery systems. Health problems/concerns of women and techniques for prevention, maintenance and/or correction. (Same as Women's Studies 425.) E

430 Suicide and Crisis Intervention (3) Factors which make suicide serious health problem. Assessment, intervention, and prevention techniques. F

435 Substance Use and Abuse (3) Drug and alcohol abuse problems and suspected causes; pharmacology of drugs and effects on society; strategies for intervention and education. Sp

465 Aging and Health (3) Aging process in health perspective as related to health promotion and wellness of aged. F, Sp

500 Thesis (1-15) P/NP only. E

502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only. E

520 Sex Education and Human Sexuality (3) Advanced in-depth discussion of educational and health counseling theory, techniques, materials used in school, community, or health care facility. Sp

530 Health Promotion and Health Education Program Development (3) Theories and principles of health promotion program development; methodology, marketing, public relations. Health education as vehicle for health promotion. Sp

540 Evaluation in Health Promotion and Health Education (3) Evaluation principles and methodologies as related to health promotion programs, products, and programs. Construction of instruments for use in assessing health education outcomes. Sp

560 Graduate Workshop (1-3) Specific health/welfare or health promotion issues. Special health problems in concentrated period of time. May be repeated. Maximum 12 hrs. E

570 Special Topics (1-3) For graduate students. In-service teachers and other health professionals. Health/welfare or health promotion issues. May be repeated. Maximum 12 hrs.

590 Research Methods in Health (3) Basic research techniques in a variety of health settings. Development of research skills and problem identification for research topic. (Same as Public Health 590.) F

593 Directed Independent Study (1-15) Individual identification and study of health/welfare or health promotion problem/issue. Specific proposal to instructor before registration. May be repeated. Maximum 12 hrs. E

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

610 Internship/Research in Safety and Health (3-6) (Same as Safety 501.)

610 Critical Analysis of Writing and Research (3) Analysis of writing and research in health related areas. F

620 Advanced Research Techniques in Health (3) Advanced theory and techniques of research design and methodologies in health discipline. Prereq: 590, 610. Sp

650 Health Aspects of Gerontology (3) Knowledge and understanding of biological, psychological and sociological aspects of aging as related to health and wellness of individuals. (Same as Public Health 650.) Su

655 Seminar in Nation's Health (3) Comprehensive study of definition, determinants, resources and health status of nation. (Same as Public Health 655.) F

660 International Health (3) Study of quality of health, health promotion and health services in countries throughout world. (Same as Public Health 660.) Sp


Public Health

Graduate study with a major in Public Health leads to the Master of Public Health (M.P.H.). Two professional preparation concentrations are available: public health education and health planning/administration. The M.P.H. program is accredited by the Council on Education for Public Health. A minor in statistics is available to interested M.P.H. students due to public health affiliation with the Intercollegiate Graduate Statistics Programs.

ADMISSION REQUIREMENTS

A statement of the applicant's educational and career goals and three rating forms are required. Request application packet from the department. Preferential consideration for admission to degree status shall be given to those with a minimum undergraduate grade-
point average of 2.8 and with at least one year of professional experience in a health-related occupation. No provisional students will be admitted. As a restricted program, non-degree admission requires department recommendation. Deadlines for completed applications are 1 March for Summer term and 1 May for Fall semester.

THE MASTER'S PROGRAM

The M.P.H. is a non-thesis program requiring completion of 58 semester hours of coursework including 9 weeks of field practice. Field practice provides a full-time experience with an affiliated health agency or organization offering one or more health programs. Of importance, field practice allows the student to apply academic theories, concepts, and skills in an actual work setting. Students must complete all assigned prequisite courses and 21 semester hours of the curriculum with a minimum overall GPA of 3.0 prior to placement in the field.

As an alternative to field practice, preparation of a master's thesis may be used to fulfill the professional skills development component of the curriculum. Approval must be received from the Public Health Academic Program Committee and is contingent on consent of major advisor, formal written proposal by the student, and completion of an additional research methods course. Written guidelines stipulating expectations and eligibility criteria are available.

MINOR IN GERONTOLOGY

Graduate students in Public Health may pursue a specialized minor in gerontology. This interunit/interdisciplinary minor gives the student an opportunity for combining the knowledge about aging in American society with his/her major concentration. Please refer to Human Ecology for specific requirements.

ACADEMIC COMMON MARKET

An agreement among southern states for sharing graduate programs allows legal residents of some states to enroll in certain programs at UT Knoxville on an in-state tuition basis. The M.P.H. program in Public Health is available to residents of the states of Arkansas, Kentucky, or Louisiana. Additional information may be obtained from the Admissions Specialist in the Office of Graduate Admissions and Records.

COURSE REGISTRATION

Provisional graduate students are ineligible to enroll in 500-level public health courses. Non-degree students must obtain permission from the department head to register for 500-level public health courses. Provisional coursework assigned as a condition of admission to the M.P.H. program must be completed promptly, with a grade of B or better, typically within the first semester or two of enrollment in graduate studies.

GRADUATE COURSES

400 Consumer Health (3) (Same as Health 400.)

410 Health in the Work Environment (3) Fundamental activities in field of industrial health aimed at reducing health problems for employees. Work place health hazards and problems of concern to nurses, medical staff, management, engineers and others in industrial health and safety fields. Prereq: Consent of instructor. May not be taken for credit by occupational health concentration majors.

493 Directed Independent Study (1-3) Individual in-depth study of selected issues. Prereq: Consent of instructor. May be repeated. Maximum 6 hrs.

502 Registration for Use of Facilities (3-15) Required for student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree completed. May not be used toward degree requirements. May be repeated. S/NC only.

509 Graduate Seminar in Public Health (1) In-depth discussion of time, place and people affecting scope of public health as discipline and its interface with many other academic and professional disciplines. Speakers both internal and external. May be repeated. 4 hrs. (Same as Nutritional Sc 450, Public Health Sc 450, Environmental Sc 509 and Social Work 509), S/NC only. F, Sp


511 Fundamentals of Industrial Hygiene (3) Occupational health theory, practice and regulations: recognition, evaluation and control of workplace health hazards. Pertinent workplace problems and situations. Prereq: 2 yrs of chemistry and biology and consent of department. F


513 Industrial Hygiene Instrumentation and Sampling (3) Instruments and methods for evaluating industrial environment for personal exposure to chemical and physical stresses affecting worker's health. Lecture, demonstration, and laboratory. Consent of major advisor. F

514 Industrial Toxicology and Occupational Exposures (3) Principles of industrial toxicology, basic toxic mechanisms, portal of entry, physiologic and biochemical responses. Occupational exposure assessment, physical factors and environmental conditions that influence exposure characterization, statistical aspects of sampling, and transport of contaminants into general environment. Prereq: 1 yr of general chemistry and 1 semester of human biology. F

520 Public Health Policy and Administration (3) Administrative considerations of community-based health care programs and health practice. Health policy formulation, political environment and governmental involvement in health, legal responsibilities, and management concepts/techniques/process. F, Sp

521 Organization Theory and Health Care Delivery (3) Administrative theory relative to health facilities: operation and management of community hospital. Case discussions and problem-solving exercises; managerial functions and skills. F

523 Management in Extended Care Settings (3) Managerial concepts and theoretical foundations essential to supervision and administration of domiciliary health services programs. Management and operation of health services programs; clients in settings which provide activities of daily living and special psychosocial environmental needs: Programs for home health services, comprehensive rehabilitation, adult day, residential, nursing homes, conggregates living centers and similar type health programs. Prereq: 521 or consent of instructor. Sp

525 Financial Management of Health Programs (3) Financial management concepts and practices applied to health services programs. Fundamentals of budgeting, cost allocation, financial management, and control. Opportunities to apply techniques. Prereq: 520 or consent of instructor. Sp

530 Biostatistics (3) Application of descriptive and inferential statistical methods to health-related problems and programs. Microcomputer applications, use and interpretation of vital statistics. Principles of data collection and analysis. Prereq: Introductory statistics or consent of instructor. F, Sp

540 Principles of Epidemiology (3) Distribution and determinants of health-related outcomes in specified populations, with application to control of health problems. Historical overview of discipline, hypothesis formulation, research design, data and error sources, measures of frequency and association, etiology-reasoning, disease screening, and injury control. Prereq: or consent. F, Sp

542 Advanced Epidemiologic Methods (3) Nature, collection, analysis and interpretation of data pertaining to cohort and case-control studies. Surveillance and surveys. Analytical methods: multiple regression and survival analysis. Experience in critiquing professional literature. Prereq: or consent of instructor. F

550 Principles and Practices of Community Health Education (3) Theoretical foundations and practical applications for community health education; opportunities for skill development in a variety of educational processes; and introduction to community health education. F

552 Community Health Problem Solving (4) Dynamic, interdisciplinary approach to planning and delivering health care services. Prereq: Consent of instructor. F, Sp

555 Health and Society (3) Understanding of social and behavioral factors which influence health status and care in America. Application to behavior in health-related organizations. Social and psycho-social aspects of disease, sociological aspects of health, delivery systems, political economy of health and illness, impact of social movements on health. Prereq: or consent of instructor. F

556 Theories and Techniques in Health Planning (4) Overview of health planning concepts and methodologies; systems-oriented planning process. Major elements of planning formulation and conceptualization. Project planning, evaluation of results, and legal considerations. Prereq: or consent of instructor. F

558 Physical Activity and Positive Health (3) (Same as Exercise Science 558.)

561 Testing, Programming, and Leadership for Diverse Populations (2) (Same as Exercise Science 561.)

563 Special Topics (3) Prereq: Consent of instructor. May be repeated under different topic. Maximum 6 hrs.

565 Seminar in Gerontology (1) (Same as Human Ecology 565, Counselor Education and Counseling Psychology 585, Exercise Science 555, Nursing 555, Physical Education 569, Sociology 569.)

567-88-89 Internship (3,3,3) Internship (community health agency or organization) in area of interest. Opportunity to practice in real settings. Prereq: MPH major, one semester advance notice and consent of major advisor. 567-88-89 available only for approved extended placements. S/N only. E

570 Research Methods in Health (3) (Same as Health 590.)

581 Directed Independent Study (1-3) Prereq: Consent of instructor. May be repeated. Maximum 6 hrs. E

650 Health Aspects of Gerontology (3) (Same as Human Ecology 569.)

585 Seminar in Nation's Health (3) (Same as Health 650.)

660 International Health (3) (Same as Health 660.)

Recreation and Leisure Studies

Graduate study with a major in Recreation and Leisure Studies leads to the Master of Science. Professional preparation concentrations are available in therapeutic recreation, general recreation, and sport administration.
management. The third concentration is an interdisciplinary program with the unit of Sport and Physical Activity in the College of Education. The M.S., with thesis and non-thesis options, requires completion of 32 semester hours. The following retention policy applies to graduate students seeking the M.S. with a concentration in sport administration/management:

1. Graduate students are required to maintain an overall 3.0 GPA.
2. Any student who falls below this standard will be advised in writing by the department head to discuss the matter with his/her advisor.
3. If a student's overall GPA remains below 3.0 for a second semester, the student will have his/her degree status revoked.

**GRADUATE COURSES**

**410 Maintenance and Management of Recreation**

And **Sports Related Facilities (3)** Principles for operationalized maintenance care, maintenance systems, and management strategies. Cost tracking, inventory systems, specialized maintenance techniques, safety guidelines, maintenance management systems and security. Prereq: 110, 310 or consent of instructor. F

**415 Managing Leisure/Sport and Related Facilities (3)** Principles of planning, designing, outfitting and operating leisure/sport related facilities such as aquatic centers, tennis complexes, activity centers. Prereq: Leisure Program Development and Evaluation, or consent of instructor. (Same as Sport Management 415.) F

**430 Organization and Administration of Leisure Services (3)** Principles of administration applied to provision of leisure services offered by public, private and/or commercial enterprises. Personnel management, evaluation, legal authority, introduction to budgeting and fiscal procedures. Prereq: 310 or consent of instructor. F

**440 Dimensions of Private and Commercial Recreation Businesses (3)** Nature and function of recreation in private, commercial, and industrial settings. Survey of development and management of commercial goods and services offered in leisure market. Factors influencing participation, management considerations, and research in commercial recreation and tourism. Prereq: 110, junior standing, or consent of instructor. Sp

**450 Specialized Study in Leisure Education (1-6)** Special interest leisure activities: developing positive attitudes toward leisure. Demonstrates how leisure contributes to one's mental and physical health. May be repeated. Maximum 6 hrs. E

**500 Thesis (1-15)** P/NP only. E

**502 Registration for Use of Facilities (3-15)** Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only. E

**510 Perspectives and Trends in Leisure Studies and Services (3)** Basic role of delivery systems in today's society, scope of leisure services, determinants of leisure behavior, developmental features of leisure and recreation. Current trends, problems, laws, and issues affected by and/or affecting delivery of leisure services. Prereq: Consent of instructor. Sp

**515 Philosophical and Conceptual Foundations of Leisure (3)** Systems of leisure and recreation; nature of philosophy, concepts of leisure, recreation, play, work, and other; history of field, and relationship of ideas to contemporary society and to professional practice. Prereq: Consent of instructor. F

**520 Program Design and Evaluation in Therapeutic Recreation (3)** History, philosophy, nature, purpose, special populations served, programming process, professional aspects of therapeutic recreation. Basic overview of aspects of leisure delivery systems. Prereq: Consent of instructor. F

**521 Facilitation Techniques in Therapeutic Recreation (3)** Role of therapeutic recreation in clinical and non-clinical settings; application of life-style planning, self-awareness, values clarification and assertiveness training in therapeutic recreation, relationship of leisure education to therapeutic recreation. Prereq: 520 or consent of instructor. Su

**522 Clinical Aspects in Therapeutic Recreation (3)** Concepts and techniques utilized by experienced and advanced therapeutic recreation specialist: clinical issues, comprehensive program concerns, administrative funding and trends in practice of therapeutic recreation services. Prereq: 520 or consent of instructor. F

**540 Fiscal Policies for Recreation and Sports Related Organizations and Facilities (3)** Application of fiscal policies and procedures to operation of recreation and sports related organizations and facilities. Finance, revenue generating strategies, cash and inventory control, commercial/public cooperative ventures and microcomputer applications. Prereq: 430 or consent of instructor. Sp

**541 Management and Operation of Recreation and Sport Related Facilities (3)** Research for making program and management decision, process of cost analysis, and basic design and maintenance of recreation and sport related facilities. Prereq: Consent of instructor. (Same as Sport Management 541.) Sp

**590 Graduate Internship (1-8)** Required of all graduate students. Minimum 100 clock hrs for each 2 hrs credit. Requires work experience, evaluation by agency and university and written paper. E

**591 Directed Study in Leisure & Recreation (1-6)** Detailed study of theories, issue, or concern. Designed to meet needs of individual students. May be repeated. Maximum 6 hrs. E

**592 Special Topics in Recreation & Leisure Studies (1-6)** May be repeated. Maximum 6 hrs. E

**Safety**

Graduate programs are available leading to the Master of Science with a major in Safety Education and Service (thesis and non-thesis options) and to the Specialist in Education with a major in Safety Education and Service. The M.S., with thesis and non-thesis options, requires completion of 30 semester hours. The Specialist in Education (Ed.S.) requires 30 semester hours beyond the M.S. An internship and research of a significant safety problem are included as professional development activities.

**ACADEMIC COMMON MARKET**

An agreement among southern states for sharing graduate programs allows legal residents of some states to enroll in certain programs at UT Knoxville on an in-state tuition basis. The M.S. and Ed.S. programs in Safety Education and Service are available to residents of the states of Alabama, Arkansas, or Florida. Additional information may be obtained from the Admissions Specialist in the Office of Graduate Admissions and Records.

**GRADUATE COURSES**

**441 Driver and Traffic Safety Education (4)** Preparation of traffic safety instructors for school, college, industry and commercial agencies. Students required to teach at least two non-drivers to drive. Valid driver's license required. 3 hrs and 2 labs. Su

**442 Advanced Driver & Traffic Safety Education (3)** Development of competence in teaching of driver education through use of simulation, multimedia, and multiple-vehicle driving range. Teaching skills and supervision. 2 hrs and 2 labs. Sp

**453 Sports & Recreational Safety (3)** Accident prevention and injury control in sports activities; philosophy of sports safety; human environmental factors and interrelationship in sports injury and control, risk-taking and decision solution strategies; and contributions of sports medicine to safety. 3 hrs and 2 labs. Sp

**452 General Safety (3)** Principles, practices, and procedures for general safety. Safety problems in school, traffic, recreation, industry, and other public areas. F, Su

**500 Thesis (1-15)** P/NP only. E

**502 Registration for Use of Facilities (3-15)** Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only. E

**532 Behavioral Problems in Safety Education & Accident Prevention (3)** Problems of behavior, causes of accidents, and application of principles of psychology in development of safe behavior in all segments of environment. F

**533 Problems and Research in Accident Prevention (3)** Safety problems found in wide variety of accidents that occur in community; findings of current research in behavioral sciences as related to variation incidence of accidents. F

**534 Organization, Administration and Supervision of Safety Programs (3)** National and local level programs; administrative, instructional, and supervisory aspects. Implementation of relevant programs. Sp

**535 Emergency Management (3)** Civil and defense problems: tornadoes, floods, fires, mass civil disorders, and nuclear and personnel attack by alien countries. Sp

**573 Graduate Workshop in Safety (3)** Special safety education problems. For advanced graduate students, teachers, supervisors, and administrators. May be repeated. Maximum 12 hrs.

**590 Special Topics (1-3)** Advanced study in selected disciplinary or professional area of safety education/management. May be repeated. Maximum 12 hrs.

**593 Directed Independent Study (1-3)** Individual identification and study of problem/issue in safety. Extensive reading and critical analysis of safety literature. Specific proposal to instructor before registration. May be repeated. Maximum 12 hrs.

**601 Internship/Research in Safety and Health (3-6)** Field experience. Significant problem identified, researched, and reported in acceptable form. May be repeated. Maximum 6 hrs. (Same as Health 401.) E

**History**

(Ph.D.)

**MAJOR DEGREES**

History................................. M.A., Ph.D.

Russell Buhite, Head

Professors:

Bergeron, Paul H., Ph.D....................Michigan State University

Chmielewski, Edward V., Ph.D.............Harvard University

Farris, W., Wayne, Ph.D...................Columbia University

Finger, John R., Ph.D....................Washington University

Haas, Arthur G., Ph.D........................Chicago University

Hao, Yen-Ping, Ph.D......................Harvard University

Haskins, Ralph W. (Emeritus), Ph.D...........California University

Jackson, Charles O., Ph.D....................Emory University

Klein, Milton M. (Emeritus) (Distinguished Prof.), Ph.D............................Columbia University

Moser, Harold, Ph.D.....................Wisconsin University

Ratner, Lorman A., Ph.D.....................Cornell University

Utey, Jonathan G. (Emeritus)............Illinois University
THE MASTER'S PROGRAM

Admission Requirements
1. Successful completion of a baccalaureate degree from an accredited institution, preferably with a major in history.
2. Acceptable scores on the Graduate Record Examination (general and subject).

General Requirements
Complete 510 and a 600-level research seminar normally during the fall and spring semesters of the first year in the graduate program. Complete 521 in preparation for the M.A. examination. As many as 9 related hours may be taken outside the department. As many as 9 graduate credits taken elsewhere may be applied toward the M.A. degree. Except by prior approval of the Director of Graduate Studies, a student's coursework must be at the 500 level or above.

Thesis Option
Twenty-four hours of coursework and 6 hours of Thesis 500 for a total of 30 hours are required. Thesis students are required to select one M.A. field and write a thesis. At the end of the program, the thesis student will stand for a two-hour oral examination on both the thesis and the field.

Non-Thesis Option
A total of 30 hours of coursework is required. At least 6 hours must be completed in each of two M.A. fields. The primary field is examined by a two-hour written examination within one week by a one-hour oral examination with the single grade of pass/fail given at the conclusion of the oral examination. No examination is given on the secondary field.

M.A. Fields
- United States (colonial to present)
- Premodern Europe
- Modern Europe
- Asia

Retention and Termination
A 3.0 overall grade-point average is required in good standing. M.A. students must take the M.A. examination no later than the semester following the completion of 30 hours. A student who fails the M.A. examination must repeat the examination no later than the following semester. A student who fails the examination a second time or does not take the examination when required will be dropped from the graduate program.

THE DOCTORAL PROGRAM

Admission Requirements
1. Successful completion of the M.A. degree from an accredited institution.
2. Acceptable scores on the Graduate Record Examination (general and subject).

Residence and Coursework
Before being admitted to doctoral candidacy, a student must:
1. Complete History 510 at UT Knoxville.
2. Complete a minimum of 6 related hours outside the department.
3. Spend two consecutive semesters in residence.
4. Complete 9 hours in each of two Group I doctoral fields. (The courses in the non-examined field must be graded A-F. There is no minimum hours requirement for a Group II field. Courses taken to fulfill M.A. requirements may be counted toward this requirement.)
5. Fulfill the foreign language requirement.
6. Complete two 600-level research seminars. (One must be completed at UT Knoxville.) Students who have completed a master's thesis need complete only one research seminar (must be taken at UT Knoxville), and History 521.
7. Maintain a 3.0 overall grade-point average in graduate work attempted.
8. Complete 21 hours of graduate coursework graded A-F at UT Knoxville beyond that required for the M.A.
9. Except by prior approval of the Director of Graduate Studies, a student's coursework must be at the 500 level or above.

Language Requirements
Students must demonstrate competence in one foreign language through coursework or examination. The student's doctoral committee may specify any other languages or research tools, such as statistics, essential for the student's preparation. The foreign language requirement must be fulfilled before taking the comprehensive examination.

Comprehensive Examination
The comprehensive examination is to be taken no later than the semester following the term in which the student has completed the residence, coursework, and language requirements. A student stands examination in one field selected from Group II below and one field selected from Group I below. Both parts are 4-hours, written, and taken during the same semester. A general oral exam will be taken following the successful completion of the two written portions. The two written and one oral exams are separate examinations, and Group I must be passed before taking Group II, and the latter passed prior to taking the oral portion. A student who fails any one of the three parts (Group I or Group II or the Oral) which constitute the Comprehensive Exam must repeat the failed exam within two semesters, excluding summer. A second failure on any one of the three parts (regardless of which one) will cause the student to be dropped from the History graduate program. Likewise, a student who does not repeat a failed exam within the allotted time (two semesters) will be dropped from the program. Upon successful completion of the residence, coursework, and language requirements and passing the comprehensive examination, a doctoral student may be admitted to candidacy.

Doctoral Fields
Group I:
- Premodern Europe
- Modern Europe
- United States (colonial to present)
- East Asia
- Africa

Group II:
- To be defined by the student's doctoral committee from within one of the following fields:
  - United States
  - Colonial and Early Republic
  - 19th century
  - 20th century
  - Regional
  - Military and Foreign Relations
  - Social and Cultural
  - American Political
  - European
  - Medieval
  - Early Modern
  - Modern
  - Political and Diplomatic
  - Intellectual and Cultural
  - Social and Economic

National Fields

Dissertation and Defense
Original research forms the basis for the dissertation. Doctoral candidates must register for a minimum of 3 hours of 600 Dissertation Research each semester and must complete 24 hours of dissertation credit. A final oral defense is given on the dissertation in its historical context. The program must be completed within eight years from admission as a potential candidate.

GRADUATE COURSES

500 Thesis (1-15) P/NP only. E.

502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only. E.

510 Foundations to Graduate Study in History (3) Assumptions and methods of historians. Required of all candidates for advanced degrees. F.

521 M.A. Readings (3) Directed readings in preparation for M.A. examinations. Open only to master's candidates in history. May be repeated. Maximum 6 hrs. S/NC only. E.


532 Topics in Modern Europe (3) Reading seminars: secondary sources on movements and trends that are multinational in focus. Focus varies. May be repeated. Maximum 15 hrs.

533 Topics in European National History (3) Reading seminars: secondary sources on intra-national topics, usually British, Russian, German or French. Focus varies. May be repeated. Maximum 15 hrs.

541 Topics in Early American History (3) Reading seminars: secondary sources on early North American
Holistic Teaching/Learning

College of Education

MAJORS

Curriculum and Instruction: M.S., Ed.D.
Education: Ph.D.
Special Education: M.S.

L. Knight, Leader

Professors:
Alexander, J. Estill, ( Liaison), Ed.D... Kentucky
Hargis, Charles H. ( Liaison),
Ed.D. Colorado State
Hipple, Theodore W., Ph.D. Illinois
Huff, P., Ph.D. Ohio State
Jost, Karl J. Ed.D. Oklahoma
Knight, Lester N., Ph.D. Texas
Kronick, Robert G., Ph.D. Tennessee
McClarn, T. Ph.D. South Carolina
Rowell, C. Glennon, Ed.D. George Peabody
Schindler, W. Jean, Ph.D. Kent State
Turner, T. N., Ed.D. Penn State
Winskiwski, Richard, Ed.D. Wayne State
Woodside, M.R., Ed.D. VPI

Associates Professors:
Chance, Charles A., Ph.D. Ohio State
Hannum, Michael C.
Ed.D. Northern Colorado

Assistant Professors:
Barnes, Rhoda, Ph.D. California ( Santa Barbara)
Hendricks, D. A., Ph.D. Alabama
McLean, J.D., Ph.D. Chicago

The Holistic Teaching/Learning unit offers graduate programs leading to the Master of Science degree with a major in Curriculum and Instruction, concentrations in elementary education, reading education, social science education, elementary teaching and in secondary teaching; and with a major in Special Education, concentration in special education. The Specialist in Education and the Doctor of Education with a major in Curriculum and Instruction; and the Doctor of Philosophy with a major in Education. The unit also houses programs for students seeking licensure in early childhood, primary, and middle school education (grades K-6 and 1-8), reading endorsement, special education licensure, and secondary social studies. See Education under Fields of Instruction for full description of all degree requirements.

The unit's central emphasis is on holistic, integrative, and interdisciplinary teaching/learning as opposed to teaching disciplinary subject content (e.g., science, mathematics, language arts) as separate entities. The focus on integration is more in line with how children learn and how language is central to the teaching/learning process. The role of the teacher in holistic teaching and learning becomes more of a facilitator of learning as opposed to a traditional role of teacher as the dispenser of content in the classroom. Central to the philosophy of holistic teaching and learning is knowing each individual child's learning style, abilities, and interests.

For further information, write the Holistic Teaching/Learning unit.

GRADUATE COURSES

419 Psychology and Education of Students with Mild Disabilities (6) Nature and characteristics of persons with mild handicaps; instructional strategies appropriate for these persons. Prereq: Special Education Principles, Special Education Strategies, 422, and Admission to Teacher Education Program. Coreq: 420. F

420 Field Experience in Modified Programs (3) Practice in teaching in modified programs: planning, developing, implementing, and evaluating instruction. Prereq: Special Education Principles and Special Education Strategies, Admission to Teacher Education and Curriculum and Instruction 422. Coreq: 420. S/NC. Only: F

421 Elementary and Middle School Science and Social Studies Methods (3) Methods and materials for teaching science and social studies. Development of functional relationships and entities of two fields. Not open to students with recent course in teaching science and/or social studies. Prereq: Admission to teacher education. F, Sp

422 Elementary and Middle School Teaching Methods I (6) Methods and materials (knowledge base) for teaching reading, language arts, mathematics, science and social studies, content and curricula overview, unit planning, daily planning, evaluation, etc., and language and concept development.

423 Language Arts/Reading Instruction in Elementary and Middle Schools (3) Language and language development as applied to teaching of oral (listening-speaking) and aspects of literacy (reading process/readiness and writing). Not open to students with recent course in language arts methods. Prereq: Admission to teacher education. F, Sp

430 Elementary and Middle School Developmental Reading Instruction I (3) Word recognition (including phonics), comprehension, evaluation, and materials. Not open to students with recent course in reading methods. Prereq: Admission to teacher education. F, Sp

431 Field Experience in Comprehensive Programs (3) Prereq: Special Education Principles and Special Education Strategies, Admission to Teacher Education and Curriculum and Instruction 422. Coreq: 420. S/NC only.

432 Psychology and Education of Students with Moderate/Severe Disabilities (6) Nature and characteristics of persons with moderate/severe disabilities and educational strategies appropriate for these persons. Prereq: Special Education Principles and Special Education Strategies, Admission to Teacher Education and Curriculum and Instruction 422.

434 Topics in Reading Education (1-6) Prereq: Admission to teacher education and course in reading education. May be repeated. Maximum 6 hrs. E


456 Speech and Language Basis of Learning Disabilities in the Classroom (3) Normal communication development, understanding of speech and language impairments in school-age children; integration of oral/written communication skills into existing curriculum, especially for high incidence speech-language education students.

470 Psychology of the Exceptional Child (3) Varieties of exceptional children; characteristics and educational needs. Implications of developmental variations for functioning as adults. Opportunity to expand study upon particular exceptionality. Enrollment limited to non-special education majors.

500 Thesis (1-15) P/NP only. E
MAJOR DEGREE
Human Ecology M.S., Ph.D.

The College of Human Ecology offers the Master of Science and Doctor of Philosophy degrees with a major in Human Ecology.

ADMISSION REQUIREMENTS
A completed file for review includes the Graduate School application file, College of Human Ecology application, Graduate Record Examination (GRE) scores, and the General section for the M.S. program in Human Ecology, the Miller’s Analogy Test (MAT) score is acceptable), and three Graduate School Rating Forms completed by individuals who can attest to the potential for graduate education. Forms may be obtained from the Dean’s Office, College of Human Ecology.

THE MASTER’S PROGRAM
The Master of Science with a major in Human Ecology is a college-wide, multidisciplinary program. This degree provides a flexible graduate program for students wishing to pursue in-depth study across subject areas of human ecology. Teachers, extension personnel, family life educators, and other professionals interested in broad-based areas will find that a diversity of subject matter combinations can be tailored to meet individual needs.

The M.S. with a major in Human Ecology offers two tracks. Track 1 is designed to meet the needs of professionals who work in programs encompassing all areas of human ecology. Track 2 is designed for students seeking initial teacher licensure in home economics education. Thesis and non-thesis options are available for both tracks.

Track 1 - The thesis option (33 hours) includes 6 hours of core courses and/or research methodology, 9 hours in program planning, implementation, and evaluation (may be selected from agricultural extension, human ecology, or other courses approved by the committee), 3 hours of Human Ecology 510, and 9 hours in courses in the college (must be selected from three departments within the college). The thesis option requires 6 hours of Thesis 500 and an oral defense.

The non-thesis option (36 hours) includes 3 hours of statistics and/or research methodology, 9 hours in program planning, implementation, and evaluation (may be selected from agricultural extension, human ecology, or other courses approved by the committee) 3 hours of Human Ecology 510, 12 hours in courses in the college (must be selected from three departments within the college) and 6 hours of approved electives. The non-thesis option requires a creative project (3 hours) and a written and oral comprehensive examination.

Track 2 - The thesis option (45 hours) includes 6 hours of statistics and/or research methodology, Human Ecology 540, 545, 574, 591, 9 hours in courses in the college (must be selected from three departments within the college) and 575 (12 hours). The thesis option requires six hours of Thesis 500 and an oral defense. The non-thesis option (48 hours) includes 3 hours of statistics and/or research methodology, Human Ecology 540, 545, 574, 591, 12 hours in courses in the college (must be selected from three departments within the college), 575 (12 hours) and 6 hours of approved electives. The non-thesis option requires a creative project (3 hours) and a written and oral comprehensive examination.

THE DOCTORAL PROGRAM
Graduate study leading to the Doctor of Philosophy with a major in Human Ecology is available in the Departments of Child and Family Studies, Health, Leisure, and Safety Sciences; Human Resource Development; Nutrition; and Textiles, Retailing, and Interior Design. Concentration areas are child development, family studies, health education, human resource development, nutrition science, textile science, and consumer environments. A major challenge of the doctoral program in Human Ecology is to draw upon the basic research generated from the natural sciences, social sciences, humanities, and the arts, and to provide a holistic perspective that contributes to the improvements of individual and family well being. Within the College of Human Ecology, research from one discipline is enhanced by encompassing and utilizing the findings of research from other disciplines.

The Ph.D. is a research degree granted only to individuals who demonstrate proficiency in conducting original research. Course requirements for the degree are determined by the student’s faculty committee, based upon college and departmental requirements and student needs and interests. The Graduate School sets minimum requirements for the doctoral degree. Additionally, the college has requirements that include:

1. Selection of a concentration and fulfillment of the requirements as directed by the major professor and approved committee;
2. Minimum of 78 semester hours in courses beyond the baccalaureate degree (exclusive of master's thesis), including College Professional Seminar in Human Ecology 610, minimum of 9 semester hours of 600-level coursework (not including dissertation), and 24 semester hours of dissertation;
3. Successful completion of written/oral comprehensive examinations as provided by each department’s procedures and the student’s doctoral committee;
4. Original research project, which culminates in a dissertation;

More specific information about the course of study is given under the individual academic departments that administer the Ph.D. concentrations.

CONCENTRATION IN CONSUMER ENVIRONMENTS

The consumer environments concentration is designed to be most appropriate for students with interests in retail and consumer sciences, foodservice and lodging administration or interior design.

Requirements are a minimum of 90 hours including:
1. HE 630.2 hours required.
2. HE 610.2 hours required.
3. HRA 532, ID 510, and RCS 550 or 641.4 hours required.
4. HRA 537 or RCS 590 or ID 590 (2 hours).4 hours required.
5. Minimum 9 hours of statistics and research methods.

6. Six hours from RCS 511, 550 or 641, ID 575, 825, HRA 555, 610, 620.6 hours required.
7. Twenty-four hours of dissertation.24 hours required.
8. Electives for 34 hours approved by the committee, including a minimum of 9 hours required at the 500 level. (Students must take at least 18 hours in one of three specialty areas: foodservice and lodging administration, retail and consumer sciences, or interior design.)

MINOR IN GERONTOLOGY
An interdepartmental/interdisciplinary minor in gerontology gives the graduate student an opportunity for combining the knowledge and experience about aging in American society with other major concentration areas.

Core courses and a practicum are offered by the College of Social Work and selected departments within the colleges of Human Ecology, Education, 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.

Declaration of a Minor
Prior to earning more than one-half the total hours required for this minor, students must complete a “Declaration of a Minor in the College of Human Ecology” form. Copies of this form are available in the Dean’s Office, Room 110, Jessie Harris Building.

Core Experience
Students must complete a core experience of 12 semester hours taken from at least three different departments including nine hours taken from outside the major department. Coursework needs to comply with the following framework:
1. Coursework, 9 hours required. A variety of coursework may be taken toward satisfaction of this requirement. Courses which are offered on a regular basis include: Health 406, 465, Health/Public Health 560, Interior Design 575, Nutrition 518, Public Health 523, Social Work 566, Sociology 415, Adult Education 522, 513.
2. Applied practicum, 2 hours required. Students should register under practicum experiences in the “home” department of the supervising faculty.
3. Human Ecology 585, 1 hour required.
4. Cross-listed with participating departments.
5. Successful completion of a written comprehensive examination covering subject matter of the minor.

Graduate Committee
At least one faculty member from the Gerontology Policy Committee who is qualified to work with graduate students, must serve on the graduate committee of each student who declares a gerontology minor. Contact Dr. Jim Moran, Associate Dean in Human Ecology, for a current list.

Admission to Candidacy
When application is made for admission to candidacy, indication of the minor must be noted on the Admission to Candidacy form.

ACADEMIC COMMON MARKET
An agreement among southern states for sharing graduate programs allows residents of some states to enroll in certain programs at UT Knoxville on an in-state tuition basis. The Ph.D. program in Human Ecology is
Human Resource Development

(Majors of College of Human Ecology)

MAJORS

Human Ecology ........................................ Ph.D.
Human Resource Development ............. M.S., Ed.D.
Vocational-Technical Education ............. Ed.S.

Gregory C. Petty, Interim Head

Professors:

Campbell, C. P., Ed.D. .............. Maryland
Cox, Ph.D. ....................... Kansas State
Craig, Cornell B. (Liaison), Ph.D. ...... Wisconsin
Hanson, Ph.D. ....................... Purdue
Haskell, R. W., Ph.D. .................. Purdue
Matthews, John I. (Emeritus), Ph.D. ..... Arizona State
Reed, J. L. (Emeritus), M.S. ............ Oklahoma State
Waggoner, G. A. (Emeritus), M.S. ...... Indiana

Associate Professors:

Lefld, B. J., Ed.D. ..................... Tennessee
Mann, E. C., Ed.D. .................... Penn State
Petty, G. C., Ph.D. .................... Missouri

Assistant Professors:

Pierce, Ph.D. .................. Ohio State
Powell, Terrence L., M.S. ............. Oklahoma

THE MASTER’S PROGRAM

The Department of Human Resource Development offers graduate programs leading to the Master of Science with a major in Human Resource Development. Two tracks are available. Track 1 is for students who are already certified to teach or those who are seeking a master’s degree without certification. Track 2 is for students seeking initial licensure. The non-thesis option is available for both tracks.

Track 1 - Concentrations are available in business and marketing education, industrial education, industrial training, and vocational-technical education. The thesis option requires the completion of 33 semester hours including 6 hours of thesis. The non-thesis option requires the completion of 36 hours of coursework.

Track 2 - Concentrations are available in business and marketing education, and technology education. The non-thesis requirement is 574 and 591, 6 hours; for business and marketing education, 531 and 532, 6 hours; for technology education, 553 and 555, 6 hours; internship, 12 hours; and 12 hours of specialty courses as approved by the student’s committee for a total of 42 hours. The thesis option requires 6 additional hours of thesis 500 for a total of 48 hours.

THE SPECIALIST PROGRAM

The Ed.D. program is a cooperative undertaking involving all vocational service areas. Concentrations are available in agricultural, business, marketing and distributive, home economics, industrial, and technical education, and in general vocational education. The degree requires a minimum of 60 hours of graduate study. Credible earned for the master’s degree may meet program requirements in the courses which contribute to the program objectives of the candidate. A major core of studies offers advanced concepts in human resource development.

THE DOCTORAL PROGRAM

The comprehensive Ed.D. program in the department is designed to provide opportunities for graduate students to achieve professional objectives, develop needed competencies, and gain desirable experiences and understanding of human resource development. The minimum requirements in the doctoral program consist of the following: department specialization, 12 hours; courses and electives, 21 hours; cognate field, 9 hours; professional education core, 9 hours; research techniques, 12 hours; and dissertation, 24 hours. A minimum of 90 hours above the bachelor’s degree is required.

The Doctor of Philosophy with a major in Human Ecology offers a concentration in human resource development.

ACADEMIC COMMON MARKET

An agreement among southern states for sharing graduate programs allows legal residents of some states to enroll in certain programs at UT Knoxville on an in-state tuition basis. The Ed.D. program is available to residents of Kentucky and West Virginia.

Additional information may be obtained from the Admissions Specialist in the Office of Graduate Admissions and Records.
457 Adapting Vocational Instruction for Special Needs Learners (3) Modification of vocational-technical programs for special needs learners. Economic, social, educational, and legal considerations and provisions for providing relevant vocational-technical education for special needs learners.  

500 Thesis (1-15) P/NP only. E  

502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when special facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only. E  

503 Problems in Lieu of Thesis (3) May be repeated. Maximum 6 hrs. S/NC only. E  


505 Selection, Placement, and Follow-up Procedures in Human Resource Development (3) Methods and procedures utilized in establishing criteria for trained selection and placement in instructional programs and in job opportunities. Analysis of job applications and reporting follow-up data appropriate for making program improvements. Prereq: Consent of instructor. Sp, Su  

509 Internship in Human Resource Development (3) Practical field experiences in selected settings under supervision of practitioner and departmental representative. Prereq: Consent of instructor. May be repeated. Maximum 8 hrs. E  

510 Foundations of Human Resource Development (3) Historical, philosophical, economical, social, and psychological foundations of vocational, technical, and adult education and human resource development; fundamental principles and contemporary objectives. Prereq: Consent of instructor. F  

511 Issues and Trends in Human Resource Development (3) Academic, socioeconomic, cultural, and other handicaps of special students. Prereq: 9 hrs of graduate credit. F, Su  

513 Special Topics in Human Resource Development (1-3) Specific objectives, activities, and evaluation. Prereq: Consent of instructor. May be repeated. Maximum 9 hrs. E  

514 Individual Study in Human Resource Development (3) Prereq: Consent of supervising instructor. Approval form must be filed in office of department head. May be repeated. Maximum 8 hrs. E  

515 Microcomputer Operations and Programming in Education (3) Operating procedures and BASIC programming for education and training applications. Hands-on experience in operating and programming microcomputers. Writing, editing and running educational programs using sequential data files. Prereq: Teaching, administrative, or related experience in education or training, or consent of instructor. E  

516 Microcomputer Software Development (3) Advanced software design in BASIC; random access and binary files, search and sort algorithms, and bittmapped graphics for educational environment. Hands-on learning and problem development. Prereq: 515 or consent of instructor. E  

518 Education Specialist Research and Thesis (3) May be repeated. Maximum 9 hrs. P/NP only. E  

530 Methods and Materials for VOE Programs (3) Development of instructional aids, recent developments and research, and individualized instructional, and occupational clusters. Prereq: 510 or equivalent. Sp, Su  

531 Organization and Supervision of VOE and Marketing Programs (3) Developing office and marketing occupations, guidelines in cooperative laboratory, and model office. Trends in office and marketing education, physical facilities, state plans, instructor qualifications and advisory committees. Prereq: Consent of instructor. F, Su  

532 Improvement of Instruction in Basic Business and Marketing Education (3) Issues, research findings, methods, and materials for improved instruction of both secondary and post-secondary levels. Prereq: 12 hrs of graduate credit. Sp, Su  

533 Improvement of Instruction in Office Technology (3) Research, principles of learning issues, and material in typing, wordprocessing, business communications, and office procedures. Prereq: Consent of instructor. Su  

534 Improvement of Instruction in Accounting and Data Processing (3) Principles of learning, issues, research findings, and methods of accounting, automated accounting and data processing at secondary and post-secondary levels. Prereq: Consent of instructor. F, Su  

535 Curriculum in Business and Marketing Education (3) Curriculum designs in career, secondary, post-secondary education, legislation, technology, social, economic and research results that affect business and marketing education. Prereq: Consent of instructor. Sp, Su  

537 Measurement in Business and Marketing Education (3) Testing and evaluation of learner performance in business and marketing education; teacher-made tests. Prereq: Consent of instructor. Sp, Su  

540 Special Topics in Business and Marketing Education (1-3) Specific objectives, activities, and evaluations vary. Prereq: Consent of instructor. May be repeated. Maximum 8 hrs. E  

541 Practicum in Business/Marketing Education (3) Practical updating and upgrading of experiences in non-traditional settings for business and marketing teachers. Prereq: 15 hrs of graduate credit. E  

542 Problems in Business and Marketing Education (3) Selective research problems in teaching of business and marketing education and related areas. Prereq: Consent of instructor. F, Su  

550 Administration of Industrial Education Programs (3) Developing, staffing, administering and evaluating trade, industrial and technical education programs in secondary and post-secondary school settings. Prereq: Consent of instructor. Sp, Su  

551 Supervision of Industrial Education Programs (3) Techniques used to improve industrial education programs. Staff development, curriculum improvement, and program updating techniques. Prereq: 455 or equivalent. F, Su  

552 History and Philosophy of Industrial Education (3) Social, political, and economic events that impact development of industrial education. Philosophical problems: justification, values, principles and concepts of industrial education. Prereq: Consent of instructor. F, Su  

553 Planning Technical Education Facilities (3) Preparation of educational specifications, site selection, and working relationships with other professionals involved in process of planning and development of education facilities. Prereq: Consent of instructor. Sp, Su  

554 Technical Program Planning (3) Instructional systems attending to analysis, design, development, implementation, and evaluation of technical education curriculum, supervisor and related training. Prereq: Curriculum development course and consent of instructor. F, Su  

555 Curriculum Planning for Industrial Education Programs (3) Developing performance-based, criterion-referenced instructional programs. Prereq: 374 or 564 or consent of instructor. Sp, Su  

556 Staff Development Programs (3) Strategies for assessing, planning, and implementing programs for professional development of vocational-technical personnel. Prereq: 551 or consent of instructor. Sp, Su  

557 Advanced Methods of Teaching Technical Subjects (3) Proper selection and effective application of innovative methods and teaching specialized skills and technical information. Diversifying and individualizing teaching of technical subjects. Prereq: 373, 564, Sp, Su  

558 Seminar in Industrial Education (1-3) Current issues, innovations, problems associated with technical programs. Prereq: 12 hrs of graduate courses. May be repeated. Maximum 6 hrs. F, Su  

559 Evaluation of Technical Training Programs (3) External and internal evaluation of training programs to maintain quality control and to justify revisions. Prereq: 455 and consent of instructor. Sp, Su  

560 International Perspective of Workforce Training (3) Examination and comparison of workforce systems in highly industrialized countries. In-school training pro- 

grams, out-of-school training systems, update training of incumbent workers, retraining displaced workers, transfer of technology, and role and responsibilities of businesses, private sector organizations/ agencies, and state and federal government agencies.  

562 Grant Writing and Project Implementation (3) Writing grant proposals, collaborating with funding sources, implementing federal grant programs, and closing out projects at end of funding support.  

564 Self-Directed Work Teams (3) Theory and practice of implementing self-directed work teams, motivating employees, increasing employee productivity via teams and related issues.  

571 Supervisory Skills for Improving Industrial Productivity (3) Philosophy of improving industrial productivity through quality and introduction to basic tools of statistical process control. Deming philosophy, control charts and interpretation, process capability, techniques for training hourly workers in quality control, and measurement procedures for quality control. Prereq: Statistics course and consent of instructor. F, Su  

572 Advanced Training Methods for Industrial Productivity (3) Techniques of training hourly workers in use of statistical process control tools. Techniques for involving hourly workers and supervisory personnel in quality assurance, inventory control, and productivity improvement. Prereq: 571. Sp, Su  

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

601 Curriculum Planning in Human Resource Development (3) Curriculum theory, models, contents, planning and implementation of instructional programs. Prereq: 555 or equivalent. Sp, Su  

602 Planning and Evaluation of Programs in Human Resource Development (3) Techniques utilized in planning, developing, and evaluating instructional programs. Prereq: 500-Level planning course and consent of instructor. Sp, Su  


605 Administration and Supervision of Human Resource Development (3) Leadership, policy, organization, planning, personnel, student development services, and budgeting relating to vocational, technical and adult education at secondary, post-secondary and higher education levels. Principles, problem solving, and management activities. Prereq: Administrative theory course and consent of instructor. F, Su  

610 Research Development in Human Resource Development (3) Proposal development, theoretical and empirical design, sampling, application of statistics, and evaluation of research in human resource development. Prereq: 6 hrs of advanced statistics courses and consent of instructor. F, Su  

611 Internship in Human Resource Development (3) Field experience in relevant organizations. Prereq: Consent of instructor. May be repeated. Maximum 6 hrs. E  

613 Special Topics in Human Resource Development (3) Prereq: Consent of instructor. May be repeated. Maximum 9 hrs. E  

618 Work Force Planning (3) Methods and procedures involved in planning, conducting, and analyzing data from national, regional, and community surveys. International manpower policies compared to U.S. policies. Application to particular fields of education. Prereq: Advanced statistics and 802. Sp  

Inclusive Early Childhood Education

(Major of College of Education)

DEGREES

MAJORS

Curriculum and Instruction ............................................. M.S., Ed.S., Ed.D.

Ph.D.

Special Education .......................................................... M.S.
GRADUATE COURSES

445 Early Childhood Education: Program Development and Teaching in Kindergarten (3) Planning, classroom organization, and management; practica for teaching young children; supervision of kindergarten to total elementary school. Prereq: Admission to teacher education. E

454 Education of the Gifted and Talented Children (3) Orientation to psychometric and behavioral studies of giftedness. Analysis of past and present school practices in reference to curriculum and program implementation. Sp

500 Thesis (1-15) P/NP only. E

502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only. E

503 Problems In Lieu of Thesis (2-3) May be repeated. Maximum 6 hrs. S/NC only. E

504 Clinical Experience in Teaching an Exceptional Children (3-9) Practicum in educational settings. May be repeated. Maximum 9 hrs. S/NC or letter grade. (Same as Rehabilitation and Deafness 504.)

506 Internships in Special Education and Rehabilitation (3-15) Placement in professional settings in public, private, or private agencies under supervision of master practitioners. Enrollment limited to those in fifth-year program. S/NC only.

515 Seminar (1-3) Curriculum, instructional technology, educational psychology, elementary education, secondary education, or social foundations as related to goals of students' programs. May be repeated. Maximum 6 hrs. S/NC only. E

516 Seminar (1-3) Curriculum, instructional technology, educational psychology, elementary education, secondary education, or social foundations as related to goals of students' programs. May be repeated. Maximum 6 hrs. S/NC only. E

518 Educational Specialist Research and Thesis (3) May be repeated. P/NP only. E

554 Assessment in Early Childhood Special Education (3) Development of knowledge and skills in appropriate formal and informal assessments of handicapped infants and young children; screening, identification, diagnosis, placement and programming assessment issues. Prereq: 553 or consent of instructor.

558 Neuromuscular and Health Disorders: Educational Implications (3) Neuromuscular, neurological impairments, physical disabilities and special health conditions, autism. Instruction of instructional techniques and adaptations.

564 Psychosocial Development of Gifted and Talented Children (3) Phenomenon of talent development in context of home, school, and society. Implications of misadjustment. Practices of promoting social and emotional development. Prereq: 451 and 452 or equivalent or consent of instructor.

565 Instructional Systems for the Gifted and Talented (3) Instructional methods and systems evaluated in terms of effectiveness in various educational environments. Prereq or coreq: 564 or consent of instructor.

566 Curriculum for Early Childhood Education (K-3) Theoretical foundations and current research in content and skill areas of curriculum for kindergarten-grade 3; application to local school setting. Prereq: Consent of instructor. May be repeated. Maximum 9 hrs. Sp, Su

577 Application of Research to Early Childhood Education (K-3) (5) Principles and practices from selected theoretical orientations. Prereq: Course in early childhood education or consent of instructor. May be repeated. Maximum 9 hrs. F, Su

568 Early Intervention for Handicapped Children (3) Exploration of characteristics and needs of young handicapped children. Program and curriculum development of early intervention system.

575 Creative Problem-Solving Strategies for Special Educators (3) Techniques for solving problems encountered by special educators. Prereq: 567 or consent of instructor.

579 Special Topics (1-3) Prereq: Admission to graduate program. May be repeated. Maximum 6 hrs. S/NC or letter grade.

584 Seminar in Early Childhood Education (3) Analysis of research and theory in early childhood education; educational process of young children. Prereq: Course in early childhood education. May be repeated. Maximum 6 hrs. Sp, Su

591 Clinical Studies (4) Relationship between educational theory and application during internship; research project, development of portfolio, and capstone experience.

593 Independent Study (1-3) May be repeated. S/NC or letter grade. E

594 Supervised Readings (1-3) May be repeated. S/NC or letter grade. E

595 Special Topics (1-3) May be repeated. S/NC or letter grade. E

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

604 Seminar in Curriculum and Instruction (1-3) Required 2 consecutive semesters. S/NC only.

610 Internship in College Teaching and Supervision (3-9) Supervised practice in college teaching and supervision. Prereq: Admission to doctoral program or consent of instructor. May be repeated. Maximum 9 hrs. S/NC only.

620 Internship in Research in Special Education and Rehabilitation (3-9) Practicum with profession engaged in theoretically-based research: public school; institutions, agencies or university settings. Prereq: 9 hrs in statistical and research methods. May be repeated. Maximum 9 hrs. S/NC only.

630 Internship in Institutional Leadership in Special Education and Rehabilitation (3-9) Advanced level field experiences under supervision of practitioner. Prereq: Consent of instructor. May be repeated. Maximum 6 hrs. S/NC only.

650 Advanced Studies in Early Childhood Education (3) Prereq: 2 graduate courses in early childhood education and consent of instructor. May be repeated. Maximum 6 hrs. S/NC only. E

679 Special Topics (1-3) Prereq: Admission to doctoral program. May be repeated. Maximum 9 hrs. S/NC or letter grade.

689 Internship (1-3) Experiences in application of principles and practices of curriculum development and instructional improvement. Prereq: Program prerequisites and consent of instructor. May be repeated. Maximum 9 hrs. S/NC only. E

693 Independent Study (1-3) May be repeated. S/NC or letter grade. E

694 Supervised Reading (1-3) May be repeated. S/NC or letter grade. E

695 Special Topics (1-3) May be repeated. S/NC or letter grade. E

Industrial and Organizational Psychology

(College of Business Administration and College of Arts and Sciences)

MAJOR DEGREES

Industrial and Organizational Psychology

Michael C. Rush (Liaison), Director

Committee:

Dobbins, Gregory H., Management
Fowler, Oscar S., Management
James, Lawrence R., Management
Johnson, Michael G., Psychology
Jones, Warren H., Psychology
Ladd, Robert T., Management
Larsen, John M., Jr. (Emeritus), Management
Lounsby, John W., Psychology
Russell, Joyce E. A., Management
Schumann, David W., Marketing, Logistics & Transportation
Sundstrom, Eric, Psychology

For complete faculty listing, see Departments of Management and Psychology.

The master's and doctoral programs are offered jointly by the Department of Psychology and the Department of Management. They are designed to prepare students for personnel, managerial, and organizational research; for university teaching; and for consulting relationships with.

The program emphasizes a scientist/practitioner model in applying and conducting research based on accepted theory, organizational behavior, psychology, management, and statistics. The programs are administered by a joint committee of the two departments, appointed by the Associate Vice Chancellor and Dean of The Graduate School on recommendations from the two department heads and the program directors.

It is intended that students entering the I/O Program will represent widely different undergraduate and graduate backgrounds including psychology, business administration, engineering, science, and liberal arts. The first year program provides the opportunity to take courses that will assist the students in attaining a reasonable level of sophistication in areas of deficiency.

ADMISSION REQUIREMENTS

Applicants for admission should request information and application forms from both The Graduate School and the Director, Industrial and Organizational Psychology Program, 408
Stokely Management Center, The University of Tennessee, Knoxville, TN 37996-0545.

Two separate applications must be completed: one application for admission to The Graduate School (apply for major in "Industrial and Organizational Psychology") and one application for admission to the Industrial and Organizational Psychology program. Deadline: New students are admitted in fall semester only, and applications must be received by the Graduates Admissions and Records Office by February 1. General Requirements

At least one year of college mathematics and one course in statistics are required. Ordinarily, an undergraduate grade point average of 3.0 or above is required with no evidence of special weakness in mathematics and physical sciences.

Test scores on each section of the general portion (verbal and quantitative) of the Graduate Record Examination (GRE) are required. Customarily, those students admitted to the program have performed at or above the 69-79th percentile on the general tests. (This corresponds to a raw score of approximately 600 on each of the tests.)

THE MASTER'S PROGRAM

A thesis is required with 6 semester hours of Management or Psychology 500.

The master's degree can be completed with a minimum of 33 semester hours in the major as follows:

Management 567, 568 or Psychology 517-18; Psychology 537, 538.

Twelve hours of additional coursework to be selected primarily from the following with the approval of the student's advisor: Management 511, 522, 610; Management/Psychology 625, 626, 627, 638; Psychology 505, 550, 610, 620, 624.

Electives, as approved for an individual's plan of study, may be selected from graduate courses in psychology, social work, sociology, management, education, planning, etc. Students who wish to pursue special research interests outside of their dissertation may register for Management 525, 526 (Maximum 6 hrs per term; courses may be repeated) or Management/Psychology 690.

An internship, practicum, or field experience is recommended. A student is expected to be in residence full time one year (two years recommended).

Doctoral candidates must pass a final oral examination on their dissertation research. In addition to course requirements, a doctoral student must pass a score of 650 (90th percentile) on the Subject GRE (Psychology-81) within two years of entry, successfully complete the qualifying examination covering scientific methodology before or during the third fall semester, and successfully complete the comprehensive examination in the areas of the student's major research and professional interests.

An overall B average is required in the course sequence Management 567-68 or Psychology 517-18 to continue in the program beyond the first year.

ACADEMIC COMMON MARKET

An agreement among southern states for sharing graduate programs allows legal residents of some states to enroll in certain programs at UT Knoxville on an in-state tuition basis. The M.S. program in Industrial and Organizational Psychology is available to residents of the state of Alabama, Arkansas, Kentucky, or Virginia. Additional information may be obtained from the Admissions Specialist in the Office of Graduate Admissions and Records.

The Department of Industrial Engineering offers a graduate program leading to the Master of Science degree with major in Industrial Engineering, concentrations in traditional industrial engineering and engineering management. The Ph.D. with a major in Engineering Science is available through the Department of Engineering Science and Mechanics with a specialization in industrial engineering.

THE MASTER'S PROGRAM

Students who enroll in the Master of Science degree may select a concentration in either industrial engineering or engineering management. Admission is open to graduates of ABET-accredited undergraduate curricula in engineering, or to graduates of other technical curricula who satisfy prerequisites depending on their academic backgrounds and industrial experiences. Policies concerning prerequisite requirements will be determined by the Industrial Engineering faculty.

Industrial Engineering

Under the industrial engineering concentration, students may select either the thesis or non-thesis option. The thesis option requires 24 hours of coursework and 6 hours. The non-thesis option requires 30 hours of coursework plus a 3-hour industrial design project.

Depending upon a student's background and career objectives, graduate work in industrial engineering enables the student to select an area of specialization from operations research, manufacturing systems, human factors engineering, information systems, quality engineering, or general industrial engineering.

Engineering Management

The engineering management concentration has an additional admission requirement of two years' industrial experience as a practicing engineer or scientist, or current full-time employment in an appropriate engineering or applied science position. The program is non-thesis and requires 33 hours of coursework plus a 3-hour capstone project. This concentration is fully supported off-campus utilizing electronic
422 Senior Industrial Engineering Problems Analysis (3) Application of industrial engineering to field assignments in local organizations, problem definitions, analysis and presentation. Prereq: 402, 403, and 405.


440 Total Quality Management (3) Philosophy of continuous improvement in organizations; management and implementation of situation analysis and analysis of systems as compared to processes analysis and improvement; Flowcharts, pareto diagrams, cause and effect diagrams and graphs, fishbone diagrams, cause and effect analysis and collection control strategies; capability analysis; quality of design; components of variation; measurement issues; issues relevant to continuous processes; managing quality in short-run environments; use of classical statistical tools: correlation and experimental design to improve system value. Lab. Prereq: Quality Control or consent of instructor.

500 Thesis (1-15) P/NP only. E

501 Design Project (1-3) Enrollment limited to industrial engineering students in the capstone program. May be repeated. Maximum 6 hrs. S/C only.

502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty from before degree is awarded may be used toward degree may be repeated. S/N only. E

513 Facilities Planning and Design (3) Modern materials handling techniques, computer-aided layout techniques, application of computer-aided design models, and use of these to design manufacturing facility. Prereq: Production Facilities Design and Material Handling or consent of instructor.

514 Information Systems II (3) Systems analysis and systems control concepts applied to systems of information. Role of IE in office and factory of future. Management support systems, decision support systems, and integrated support systems.

515 Production and Inventory Systems (3) Application of OR techniques to production and inventory system. Deterministic and stochastic inventory models. Use of mathematical programming for product mix, process selection, blending and aggregate planning production problems. Application of simple and complex queuing models in manufacturing environment. Prereq: 402 or Engineering Management 537 or consent of instructor.


521 Human Factors Engineering Methodology (3) Background in methodology used by human factors engineering designer and systems analyst. Observational methods, functional analysis, interface design, computer-aided design techniques, computerized methods, human reliability and human error prediction, training analysis, evaluation of man-machine interfaces, subjective and objective techniques, scaling techniques, questionnaire and survey design, critical incident technique, consensus techniques (Delphi), accident investigation, behavioral instrumentation, performance measurement, statistical techniques in experimental design, and expert systems. Prereq: 520.

522 Optimization Methods in Industrial Engineering (3) Classical optimization theory, unidimensional and multidimensional search techniques, Lagrangian relaxation, separable programming, linearization techniques, quadratic programming, and dynamic programming. Prereq: 405 or 523.

523 Linear Programming and Extensions (3) Simplex and revised simplex methods, duality, parametric and post-optimality analysis, use of LP software integer programming techniques, branch and bound and cutting plane network programming. Prereq: 401 or 537.


591-92-93 Special Topics in Industrial Engineering (3,3,3) Individual or group research projects. Prereq: Consent of instructor. May be repeated.

601 Operations Research Models in Engineering Economy (3) Mathematical modeling techniques applied to capital budgeting; advanced topics in multiple attribute decision analysis; Bayesian analysis of sequential decision making, artificial intelligence in complex decision analyses. Prereq: 518, 522.


604 Advanced Topics in Optimization (3) Multi-stage optimization theory. State-space dynamic programming techniques and applications to various problems. Prereq: 522, 523.


691-92-93 Advanced Topics in Industrial Engineering (3,3,3) Forum to study individually or in groups. Prereq: Graduate standing and consent of instructor. May be repeated with consent of instructor.

Industrial Engineering

GRADUATE COURSES


401 Integrated Manufacturing Systems (3) NC and CNC machine tools, robotics and related materials handling systems, hand automation, alternative integrated manufacturing systems, and manufacturing information control systems. Prereq: 400.

402 Production System Planning and Control (3) Theory and application of forecasting systems, regression and time series analysis and control. Inventory models, development of safety stock. Coverage of all modules of Manufacturing Resource Planning (MRP) Systems: master production scheduling, resource requirements planning, bill of material and inventory file structure, material requirements planning, capacity planning, shop floor control and integration. Overview of just-in-time inventory concepts and MRP's role in manufacturing automation. Prereq: 301.

403 Production Facilities Design and Material Handling (3) Design of production facilities: plant layout, analysis and planning for overall moving, packaging and storage of materials. Office layout and service areas. Design of facilities for such diverse groups as hospitals, banking, industry. Prereq: 302, 401.

405 Engineering Economy (3) Methods and problems in selection of equipment and installations. Decisions among engineering alternatives involving capital recovery, economic life of equipment, and rate of return on investment.


410 Predicted Time Systems (2) Work design and measurement using predetermined time system: Methods Time Measurement, Basic Motion Study or Work Factor. Prereq: 403.


412 Quantitative Methods in Project Management (2) Project planning, scheduling, and control based on network and matrix techniques. Decision making in timing and resource allocation. Techniques used in cost estimating, multi-project control, computer applications, and PERT methods of handling uncertainty in activity time estimates.


Engineering Management

GRADUATE COURSES


502 Registration for Use of Facilities (3-15) May not be taken toward degree requirements. May be repeated. Maximum 6 hrs. S/N only.
continuing education activities which will promote the development and improvement of information systems and services such that the school's contributions reach beyond its immediate academic programs. The school will provide:

1. Continuing education for information professionals and, on a selective basis, to persons outside the information field.
2. Advisory services to information organizations.
3. Leadership for professional associations.
4. To conduct basic and applied research which promotes the generation of new knowledge, services and technology. The school will encourage:
   1. Research which strengthens its instructional and public service programs.
   2. The use of a variety of research methods.
   3. Sharing the results of its research.
   4. Increased research quality and productivity.

Admission Requirements

Applicants to the information sciences program must have a minimum undergraduate grade-point average of 3.0 or a satisfactory graduate degree grade-point average for admission as a potential candidate for the MS degree.

The verbal and quantitative aptitude portions of the Graduate Record Examination (GRE) are required of all applicants unless a graduate degree has been completed prior to application for admission. Applicants should take the GRE at least one semester in advance of application for admission and are expected to score in the 50th percentile or above on the verbal portion of the GRE.

A personal data sheet and three recommendations (obtained from the School of Information Sciences) should be returned to the admissions office of the school. Foreign applicants are required to take the Test of English as a Foreign Language.

The Master's Degree

The program leading to the Master of Science involves a total of 43 semester hours of graduate courses, 15 hours of which form a core curriculum required of all students. Either a thesis or a non-thesis option is available, with 6 hours required for thesis credit. At least 37 hours must be taken in the School of Information Sciences, allowing up to 6 hours outside the school with a maximum of 6 from outside the University. Upon completion of the program, all students are subject to a final examination. For students who elect the thesis option, the examination will be a defense of the thesis. Students who elect the non-thesis option will be given a written comprehensive examination.

Core Curriculum

The core curriculum is a 16 semester hour sequence of six courses required of all students: 490, 520, 530, 560, 580. These courses address the evolving information environment: foundations of information sciences and technologies; information resources selection, acquisition and evaluation; information content representation; information access and retrieval. The core curriculum includes a one-hour electronic information and communications laboratory experience required of students during the first semester: 504.
programs at UT Knoxville on an in-state tuition basis. The M.S. program in Information Sciences is available to residents of the states of Arkansas, Georgia, Virginia, or West Virginia. Additional information may be obtained from the Admissions Specialist in the Office of Graduate Admissions and Records.

**GRADUATE COURSES**

430 History of the Book (3) History of writing and various methods of bookmarking.
450 Writing About Science, Technology, and Medicine (3) (Same as Journalism 450.)
475 Utilization of Instructional Media (3) (Same as Education in the Sciences, Mathematics, Research and Technology 475.) E
485 Electronic Communications and Information Resources on Internet (3) Exploration of worldwide information and communication resources including e-mail, gopher, Archie, Veronica, WAIS, WWW, and newsgroups.

490 Information Environment (3) Generation, production, management, dissemination, and use of information.

492 Information Access and Use (3-5) Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only. E

500 Thesis (1-15) P/NP only. E

502 Registration and Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only. E

504 Electronic Information and Communications Laboratory (1) Methods for creating and managing information in electronic form. Communication of electronic information in networked environments. Location and use of electronic information resources. For GSI's and graduate students only; must be completed satisfactorily in first semester. S/NC only. F,Sp

520 Information Content Representation (3) Principles of distinguishing, describing, and indexing intellectual works; current approaches: citation systems, descriptive cataloging, non-subject indexing, pre- and post-coordinate subject indexing, classification and categorization; authority control of index terms; standards. F,Sp,Su,A

521 Cataloging and Classification (3) Basic library-oriented cataloging and classification techniques, tools, and strategies. Descriptive cataloging, choice of form of non-subject entries, subject heading work, general classification, authority control, bibliographic utilities, online library catalog. F

522 Advanced Cataloging and Classification (3) Cataloging and classification of more difficult materials, use of larger classification systems and subject heading systems. Library of Congress Classification, Library of Congress Subject Headings, and introduction to Medical Subject Headings. Prsma: 521 Sp

523 Abstracting and Indexing (3) Philosophies, standards, and procedures for manual and automatic document indexing, back-of-the-book indexing, vocabulary control, thesaurus construction, and abstracting.

530 Information Access and Retrieval (3) Media for information storage, logical and physical information structures, query logic and languages, search strategies and heuristics, user interfaces, evaluation of retrieval system performance. Search techniques for various types of databases including manual, full-text, numeric, bibliographic. F,Sp,Su,A

531 Sources and Services for the Social Sciences (3) Information sources in political science, sociology, psychology, geography, history, anthropology, business, and education. F

532 Sources and Services for Science and Engineering (3) Information sources in engineering, physical and life sciences. Sp

533 Sources and Services for the Humanities (3) Information sources in philosophy, religion, fine arts, performing arts, literature, and language. Organization and management of regional collections. F

534 Government Information Sources (3) Selection, acquisition, organization, and utilization of government information in a variety of forms, including legislative, judicial, and executive branches of federal, state, local, and international government and intergovernmental agencies.

535 Advanced Information Retrieval (3) Bibliographic, non-bibliographic, full-text databases, e.g., non-bibliographic formula and structure databases, content-page/full-text databases, patents, document delivery, evaluation, and testing.

536 Creation and Distribution of Information and Knowledge Resources (3) Historical, political, and societal dimensions of creation, dissemination, growth, and institutionalization of information and knowledge from Aristotle's Lyceum to twentieth-century university and research environments.

537 Information Industry (3) Issues and trends concerning information industry: products and services, Standards, enabling technologies, choices of distribution media, entrepreneurial opportunities. Legal, ethical, and quality concerns. F

538 Economics of Information (3) Costing and pricing of information; value of information and value added services, cost-benefit analysis and tradeoffs; policy issues related to economic aspects of information exchange and transfer. F

539 Information Policy (3) Role of government in creation and exchange of information; review of key national and international policy areas relevant to information creation, production, and distribution; development of information policy for organizations. Sp

540 Research Methods (3) Research methods in variety of information environments; primary and secondary research; research project design; research results interpretation; analysis of published research; techniques supporting research process. E

550 Management of Information Organizations (3) Supervisory and management concepts, strategies, and techniques applicable to information professional work in libraries, archives, records management, and other information organizations. F

551 School Library Media Centers (3) Planning, implementing, and evaluating school library programs. Curricular involvement, role of technology, site-based management, relationships with district and state services. F

552 Information Centers in Higher Education (3) Development, mission, trends, issues, users, services, and environment of campus information centers including libraries and alternative information resources center and library-computer center models. F

553 Specialized Information Agencies (3) Development and present status, scope and objectives, Administrative and organizational problems and techniques. F

554 Public Library Management and Services (3) Development, roles, political environment, governance, organization, fiscal management, services, marketing, and performance evaluations. Sp

555 Scientific and Technical Communications (3) Evolution of scientific and technical communication; current trends; role of formal and informal communications; major STI organizations and their roles. F

557 User Instruction (3) Theory, strategy, design, and practice in providing instructional services and technology for end users of information and information systems. Includes practical experience.

560 Information Resources Selection, Acquisition, and Evaluation (3) Principles of development and management of collections in information agencies; community analysis; users and uses; policies and procedures; evaluation of items and collections; selecting items to meet particular needs. F,Sp,Su,A

561 Contemporary Book Publishing (3) Creation, design, production, marketing, and distribution; various types of publishers. Sp

562 Serials (3) Serials collections: selection, acquisition, cataloging, preservation, use, and public services. Su,A

563 Graphic Design and Media (3) Principles and practice in visual aspects of communications. Graphic
584 Corporate Information Systems (3) Objectives and functional elements of records systems, archival programs, management information systems and technologies within various types of organizations. F, Sp.


586 Environmental Scanning for Information Professionals (3) Principles and practice of environmental scanning; information evaluation and synthesis; role of strategic information in modern organization.

587 Information Network Applications (3) Scholarly and community-based electronic communications; national and international standards, tools, resources; identification, analysis, evaluation, and management of tools and resources; construction of local technologies as developed and applicable. F.

588 Information and Communication Technologies (3) Concepts and terminology of information transmission. Information network architecture and standards. Contemporary and emerging information networking technologies. F.

590 Problems in Information Sciences (3) Prereq: Consent of instructor. May be repeated. Maximum 6 hrs.


592 Seminar in Information Sciences (3) Prereq: Consent of instructor. May be repeated with consent of advisor. Maximum 6 hrs.

593 Independent Study (3-6) Prerequisite: Consent of advisor. Maximum 6 hrs. F, Sp.

594 Graduate Research Participation (3) Advanced research techniques as supervisor of staff research director whose area coincides with interests of student. Prerequisite: Consent of advisor and research director. S/N only. F, Sp.

598 Psychology of Human-Computer Interaction (3) Survey of human-computer interaction and introduction to psychological and other behavioral science knowledge and techniques useful in design of computing systems for human users. Basic psychological phenomena of human cognition, problem solving, and language and how these processes relate to and condition interaction between humans and interactive computing systems. Sp.


473 Black Male in American Society (3) Development of historical images, myths and stereotypes. Impact of critical factors: Black feminism, violence, concepts of masculinity, family, white males, white females, homophobia, nationalism, and athletics.

483 African-American Women in American Society (3) Historical and contemporary socio-eco-political factors in American society as related to Black women. (Same as Women's Studies 483.)

421 Topics in Italian Literature and Cinema (3) (Same as Italian 421.)

486 Special Topics in Film (3) (Same as English 486.)

Comparative Literature GRADUATE COURSES

401-02 Special Topics in Comparative Literature (3,3) Content varies. May be repeated. Maximum 9 hrs.

402 Latin American Studies Seminar (3) (Same as Comparative Literature 401.)

Linguistics GRADUATE COURSES

400 Topics in Linguistics (3) Content varies. May be repeated. Maximum 6 hrs.

411 Linguistic Anthropology (3) (Same as Anthropology 411.)

420 The Development of Historical Linguistics as a Science (3) Scientific understanding of language change. Emergence of Neogrammarian paradigm from 19th-century intellectual trends. Impact of synchronic, descriptive, and transformational-generative linguistics on contemporary diachronic theory. Prereq: 6 hrs of courses required for linguistics concentration or consent of instructor.

425 Introduction to Descriptive Linguistics (3) (Same as French, German, Russian, and Spanish 425.)

426 Methods of Historical Linguistics (3) (Same as German 426, French 426, Russian 426, and Spanish 426.)

429 Romance Linguistics (3) (Same as French 429 and Spanish 429.)

430 The Development of Synchronic Linguistics as a Science (3) Development of first synchronic paradigm of linguistics. Impact of social sciences on American descriptive/pragmatics, Prague School, Transformational-generative theory. Prereq: 9 hrs of courses required for linguistics concentration or consent of instructor.

435 Structure of the German Language (3) (Same as German 435.)

436 History of the German Language (3) (Same as German 436.)

471 Sociolinguistics (3) (Same as English 471 and Sociology 471.)

472 American English (3) (Same as English 472.)

474 Teaching English as a Second or Foreign Language (3) (Same as English 474.)

475 Teaching English as a Second or Foreign Language II (3) (Same as English 475.)

485 Special Topics in Language (3) (Same as English 485.)

Interdisciplinary Programs

Interdisciplinary Programs

(College of Arts and Sciences)

The College of Arts and Sciences offers a series of interdisciplinary undergraduate majors and minors through its Interdisciplinary Programs. These programs include African and African-American Studies, American Studies, Ancient Mediterranean Civilizations, Asian Studies, Cinema Studies, Comparative Literature, Latin American Studies, Linguistics, Medieval Studies, Russian and East European Studies, Urban Studies, and Women's Studies. Certain courses within these programs are available for graduate credit as listed below. See the Undergraduate Catalog for program descriptions and directors.

African and African-American Studies

GRADUATE COURSES


450 Issues and Topics in African-American Studies (3) Problems, topics, issues, and individuals. May be repeated. Maximum 6 hrs.

452 Black African Politics (3) (Same as Political Science 452.)

461 African Prehistory (3) (Same as Anthropology 461.)
URBAN STUDIES

GRADUATE COURSES
401 The City in the U.S. (3) (Same as Planning 401.)
441 Urban Geography (3) (Same as Geography 441.)
464 Urban Ecology (3) (Same as Sociology 464.)

WOMEN'S STUDIES

GRADUATE COURSES
400 Topics in Women's Studies (3) Content varies. May be repeated.
422 Women Writers in Britain (3) (Same as English 422.)
425 Women's Health (3) (Same as Health 425.)
434 Psychology of Gender (3) (Same as Psychology 434.)
466 Rhetoric of the Woman's Rights Movement to 1930 (3) (Same as Speech Communication 466.)
476 Rhetoric of the Contemporary Feminist Movement (3) (Same as Speech Communication 476.)
483 African-American Women in American Society (3) (Same as African-American Studies 483.)

JOURNALISM

(College of Communications)

MAJOR
Communications M.S., Ph.D.

James A. Crook, Director

Professors:
Adams, J., Ph.D., Pennsylvania State (Emeritus)
Ashdown, P.G., M.A., The Ohio State University
Bowles, D., Ph.D., University of Wisconsin
Cade, C., M.A., Ph.D., University of Southern Illinois
Crook, J.A., Ph.D., Iowa State University
Everett, G.A., Ph.D., University of Iowa
Haskins, J.B., M.A., Ph.D., University of Wisconsin
Lane, J.L., Ph.D., University of Minnesota
Leiter, B.K., Ph.D., University of Pennsylvania

Associate Professors:
Caudill, C., Ph.D., University of North Carolina
Heller, R.B., M.A., Syracuse University
Lucarelli, S., Ph.D., University of Tennessee
Morris, L., Ph.D., University of Toledo

Assistant Professor:
Foley, D., M.A., University of Michigan (Northwestern)

The School of Journalism offers a concentration area for the master's with a major in Communications and participates in the interdisciplinary doctoral program. See Communications for additional information.

GRADUATE COURSES
403 International Communications (3) Development and operations of world mass communication channels and agencies. Comparative analysis of media, media practices, and flow of news throughout world. Print and broadcast systems in terms of social, political, economic, and cultural factors. Relation of communication practices to international affairs and understanding. S, Sp
412 Opinion Writing (3) Analysis of editorial positions, practices, and pages. Writing of editorials and columns for newspapers, magazines, and company publications, rhetorical devices and use of logic. Prereq: Communications 200, or consent of instructor.
414 Magazine Article Writing (3) Techniques of writing in-depth articles of mass circulation and specialized magazines. Organization and presentation of material, problems in specialized areas: business, science, agriculture, humanities. Prereq: Communications 200, or consent of instructor.
416 Issues in Journalism (3) Topics vary. Prereq. of instructor. May be repeated. Maximum 6 hrs.
420 Print Media Management (3) Current business practice among print news media, especially newspapers. Problems in management and production and outlook for new technologies. Prereq: 6 hrs mathematics and/or accounting and senior standing. S, Sp
430 Public Affairs Reporting (3) Reporting and writing about courts, government, and public agencies. Event and issue-oriented journalism of politics and public affairs. Prereq: 300 E, Sp
433 Advanced Editing (3) Sensitivity to language and editing skills. Headline writing, layout, and production. Prereq: 203.
444 Journalism as Literature (3) Study of writers from 17th century to modern era whose works have endured as both journalism and literature. Emerging genre called literary journalism: means of cultural reporting with personal narrative style. Prereq: Consent of instructor.
450 Writing About Science, Technology, and Medicine (3) Writing workshop to analyze examples of successful scientific writing and write series of articles for general public based on scientific journals, news conferences, technical meetings, and interviews. Prereq: Consent of instructor. (Same as Science 450.) F, Sp
451 Environmental Reporting (3) Writing for news media on such environmental issues as acid rain, water pollution, air pollution, allenaries, nuclear power, fossil fuel power, and solid wastes. Presentations and interviews of experts in environmental science and reporting. Examples in writing exercises in environmental reporting. Prereq: Editing for majors; consent of instructor for non-majors.
455 Issues in Science Communications (3) Topics vary. Prereq. Consent of instructor. May be repeated. Maximum 6 hrs.
456 Science Writing as Literature (3) Survey of important science writing for general public across spectrum of science, engineering, and medicine. Works by authors such as Arthur C. Clarke, Stephen J. Gould, and Richard Selzer. Analysis of literary qualities in quest to understand why some science writing succeeds. Prereq: Consent of instructor.
460 Mass Communications History (3) Development of press and role of mass communications in American history. Newspapers, radio, television, and magazines. F
470 Public Relations Campaigns (3) Research, planning, and programming, and evaluation of public relations campaigns. Prereq: Consent of instructor.
480 Journalism in the High School (3) Functions and methods of high school public relations. Oral and written presentation of public relations projects from inceptiion to completion. Extensive out-of-class work. Prereq: Consent of instructor.
481 Advanced Photographic Techniques (3) Advanced principles and methods of black-and-white photography. Equipment and technique. Prereq: Consent of instructor. F

DEGREES
MAJOR
Communications M.S., Ph.D.

James A. Crook, Director

Graduate faculty members:

Hodge, R.L., Ph.D., University of Texas
Ryan, T.K., Ed.D., State University of New York
Watkins, J.P., M.S., University of Tennessee

The Language, Communication, and Humanities Education unit offers graduate programs leading to the degrees of Master of Language, Communication, and Humanities Education

(Completion of core curriculum)

MAJOR
Communications M.A., M.S., Ed.S., Ed.D.

Patricia Davis-Wiley, Leader

Graduate faculty members:

Christensen, M.A. (Emeritus), Ph.D., University of Kansas
Davis-Wiley, Patricia D., Ed.D., University of Houston
Hull, H.N., Ed.S., University of Tennessee

The Language, Communication, and Humanities Education unit offers graduate programs leading to the degrees of Master of
Science with a major in Curriculum and Instruction, concentrations in art education, English education, foreign language education, reading education, and secondary teaching; the Specialist in Education, and the Doctor of Education with a major in Curriculum and Instruction; and the Doctor of Philosophy with a major in Education. The unit also offers programs of study leading to teaching licensure in art, English as a second language, foreign language, speech communications, and theatre. See Education under Fields of instruction for full description of all degree requirements.

For further information, write the unit leader.

Art Education

GRADUATE COURSES

510 History and Philosophy of Art Education (3) United States from 1860's to present. Prereq: Consent of instructor.

520 Studies in Art Education (3) Issues and topics current to the field of art education. Prereq: Consent of instructor.

530 Production and Critical Analysis of Art (3) Relationship of production and critical analysis of works of art to discipline-based art education.

540 Instructional Materials and Production Related to the Teaching of Art (3) Development and use of instructional aids concerned with all aspects of teaching art: videotapes, audiotapes, slides, charts, and learning packs.

550 Special Topics in Art Education (3) Prereq: Consent of instructor. May be repeated. Maximum 6 hrs.

Language, Communication, and Humanities Education

GRADUATE COURSES

455 Teaching of Foreign Languages, Grades 7-12 (3) Instructional methods, lesson planning, peer-teaching; materials for teaching foreign language and culture; evaluation techniques. Required for certification in modern foreign languages and Latin. Prereq: Completion of one year of study in a modern foreign language; consent of instructor.

459 Teaching English in the Secondary School (3) Techniques of teaching composition, language, and literature. Prereq: Admission to Teacher Education Program.

460 Teaching Reading and Literature in the Secondary School (3) Approaches for teaching basic reading skills and ways of teaching literature.

461 Developing Reading Skills in Content Fields (3) Techniques for teaching reading and study skills in content areas of school program. Extensive assessment of textbooks. Middle school and high school level.

500 Thesis (1-15) P/NP only. E

502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only. E


507 Teaching Poetry Grades 7-12 (3) Research and theory in application to teaching of poetry. Design of strategies and materials for teaching and writing and reading of poetry. Review of texts and materials.

509 Teaching Composition in the Secondary School (3) Teaching narration, description, exposition, and argumentation; writing process and marking of student papers.

509 Teaching Fiction in the Secondary School (3) Teaching of novels and short stories.

513 Seminar (1-3) Curriculum, instructional technology, elementary education, secondary education, or social foundations as related to goals of students' programs. May be repeated. Maximum 6 hrs. S/NC only. E

516 Seminar (1-3) Curriculum, instructional technology, elementary education, secondary education, or social foundations as related to goals of students' programs. May be repeated. Maximum 6 hrs. S/NC only. E

519 Educational Specialist Research and Thesis (3) May be repeated. P/NP only. E

533 Reading in Community College: Research and Theory (3) Analysis of components of effective community college reading programs. Attention to research and theoretical bases. Prereq: Course in reading education or consent of instructor.

551 Foreign Language in the Elementary Schools Practicum (3) Experiences designing, implementing and assessing second language instruction in elementary school setting. Prereq: 587 or consent of instructor.

556 English as a Second Language Practicum (3) Experiences designing, implementing and assessing English instruction to non-native English speakers. Required course for ESL certification. Prereq: 578 or consent of instructor.

578 Teaching English as a Second Language (3) Instructional methods: utilization of assessment procedures to diagnose English linguistic proficiency, materials for non-native speaker in K-12 classroom. Required for Tennessee ESL (K-12) licensure. Prereq: 587 or consent of instructor.


590 Seminar in Teaching English in Secondary Schools (3) Content varies. Theoretical and practical approaches to teaching English in secondary school. May be repeated. Su

592 Linguistics and the Teaching of English (3) Grammar, usage, semantics, dialectology, history of language, and lexicography.

593 Independent Study (1-3) May be repeated. S/NC or letter grade. E

594 Supervised Readings (1-3) May be repeated. S/NC or letter grade. E

596 Special Topics (1-3) May be repeated. S/NC or letter grade. E

597 Teaching Drama Grades 7-12 (3) Strategies and materials for teaching creative dramatics, enacting and writing of plays, reading of scripts.

598 Developing Speaking and Listening Skills, Grades 7-12 (3) Teaching approaches to nonverbal communication, interpersonal and group communication, public address and listening. Review of tests and materials.

600 Doctoral Research and Dissertation (3-15) May be repeated. S/NC or letter grade. E

601 Studies in English Education (3) Issues and research in teaching of English.

604 Seminar in Curriculum and Instruction (1) Required 2 consecutive semesters. S/NC only. E

605 Organizing and Administering Reading Programs (3) Analyzing and synthesizing instructional, learning, and materials components into classroom, school and system programs. Prereq: 2 500-level courses in reading education or consent of instructor.

678 Advanced Studies in English as a Second Language (3) Research, curricula, assessment, trends and issues in foreign language education. Prereq: 578 or consent of instructor.

689 Internship (1-3) Experiences in application of principles and practices of curriculum development and instructional improvement. Prereq: Program prerequisites and consent of instructor. May be repeated. Maximum 8 hrs. S/NC only. E

693 Independent Study (1-3) May be repeated. S/NC or letter grade. E

694 Supervised Reading (1-3) May be repeated. S/NC or letter grade. E

695 Special Topics (1-3) May be repeated. S/NC or letter grade. E

Large Animal Clinical Sciences

See College of Veterinary Medicine and Comparative and Experimental Medicine

Law

(College of Law)

MAJOR DEGREES

Law J.D., J.D.-M.B.A., J.D.-M.P.A.

Richard S. Wirtz, Dean

Professors:

Best, Reba, M.L.S.., J.D. ................. Florida

Blaze, Douglas A., J.D. ............. Georgetown

Cohen, Neil P., LL.M., J.D.... Harvard

Cook, Joseph G., LL.M. .......... Yale

Dessens, Lawrence, J.D. .......... Harvard

Gray, R. Macdonald (Emeritus), L.L.M. .... George Washington

Hardin, Patrick, J.D. ............... Chicago

Hess, Amy M., J.D. ................. Virginia

Jones, Durward S. (Emeritus), J.D. .... North Carolina

King, Joseph H., J.D. .............. Pennsylvania

Lacey, Forrest W. (Emeritus), J.D. ........ S.D., J.D.. Michigan

Lee, Gregg, Frederic S., J.L.B ...... Duke

Lloyd, Robert M., J.D. ............. Michigan

Miller, Charles H. (Emeritus), J.D. .... Duke

Overtorn, Elvin E., (Emeritus), S.J.D.. Harvard

Phillips, Jerry J., J.D. .............. Yale

Piquet, Cheryl, M.S.L.S. ......... Tennessee

Rivkin, Dean H., J.D. ............... Vanderbilt

Sewell, Toxey H. (Emeritus), L.L.M. ....... George Washington

Sobieski, John L., J.D. ............ Michigan

Wirtz, Richard S., J.D. .......... Stanford

Associate Professors:

Aarons, Dwight, J.D. ............ UCLA

Anderson, Gary L., LL.M. ......... Harvard

Anshul, Frances Lee, LL.M. ...... Harvard

Bean, William J., J.D. .......... Miami

Black, Jerry P., Jr., J.D. .......... Vanderbilt

Bunker, Mary Garrett, J.D. ...... George Washington

Comett, Judy M., J.D. .......... Tennessee

Davies, Thomas Y., J.D. ........ Northwestern

Gray, Graywine, J.D., J.D. ....... Vanderbilt

Kennedy, Deaerie A., L.L.M. .......... Temple

Leatherman, Don A., L.L.M. ........ New York

Parker, Carol M., J.D. .......... California
Pierce, Carl A., J.D. ................................ Yale
Plank, Thomas E., J.D. ............................ Maryland
Reynolds, Glenn H., J.D. .......................... Yale
Stark, Barbara, J.D. ................................. New York
Stein, Gregory M., J.D. ............................ Columbia
Thompson, James E., J.D. .......................... Florida
Wertheimer, Barry M., J.D. ....................... Duke

Assistant Professors:
Browne, Kelly K., J.D. .............................. Cincinnati
Thorpe, Steven R., J.D. ............................. Mercer

Instructors:
Hoover, Mary Jo, J.D. .............................. Brooklyn
McAlpine, Janice E., J.D. ............................ Michigan
Moore, Jean (part-time), M.A.L.S. .............. Michigan
Wolf, Pamela L., M.S.S.W. ....................... Tennessee

The College of Law offers the Doctor of Jurisprudence degree program; a dual degree program with the College of Business Administration leading to the J.D. 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 J.D. and the Public Administration degree. 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 in the College of Law Bulletin from the Admissions Office, The University of Tennessee, College of Law, 1505 West Cumberland Avenue, Knoxville, Tennessee 37996-1800. Completed application should be received before February 1 of the year of requested admission.

DEGREE OF DOCTOR OF JURISPRUDENCE

The degree of Doctor of Jurisprudence will be conferred upon candidates who complete, with the required average, six semesters of resident law study and who have 89 semester hours of credit, including all required courses.

The required average is 2.0 and that average must be maintained on the work of all six semesters and on at least a grade of B or better in the combined work of the grading periods in which the last 28 credit hours taken in residence were earned.

Averages are computed on weighted grades. Grades are on a numerical basis from 0.0 to 4.0. A grade of 0.9 or below is a failure.

Eligible law students may receive up to six (6) semester hours of credit toward the J.D. degree for acceptable performance in upper-level courses that materially contribute to the study of law and which are taken in other departments at The University of Tennessee. Course selection and registration are subject to guidelines approved by the law faculty which include the requirement that any such course be acceptable for credit toward a graduate degree in the department offering the course. Refer to the Law Bulletin for current degree requirements.

Concentration in Business Transactions

Students interested in a concentration in business transactions must complete all of the following law courses:
- 826 Introduction to Business Transactions
- 827 Business Associations
- 971 Income Taxation of Entities
- 940 Land Finance Law
- 840 Commercial Law
- 842 Contract Drafting Seminar
- 833 Representing Enterprises

None of the above courses may be taken on an S/NC basis (with the exception of 626). This course is not required for students who have an undergraduate major in accounting, finance, or business administration, who hold the MBA degree, or who are enrolled in the dual J.D.-MBA program. Waivers may also be granted to students who have acquired the requisite business knowledge through other coursework or through practical experience.

DUAL J.D.-M.B.A. DEGREE PROGRAM

The College of Business Administration and the College of Law offer a coordinated dual degree program leading to the conferral of both the Doctor of Jurisprudence and the Master of Business Administration degrees. A student pursing the dual program is required to take fewer hours of coursework than would be required if the two degrees were to be earned separately.

Admissions

Applicants for the J.D.-M.B.A program must make separate application to, and be competitively and independently accepted by, the College of Law for the J.D. degree and The Graduate School and College of Business Administration for the MBA degree, and by the Dual Degree Committee. Students who have been accepted by both colleges may commence studies in the dual program at the beginning of any term subsequent to matriculation in both colleges provided, however, that dual program studies must be started prior to entry into the last 28 hours required for the J.D. degree and the last 16 hours required for the MBA degree.

Curriculum

A dual degree candidate must satisfy the graduation requirements of each college. Dual degree students withdrawing from the dual degree 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 degree program. For students continuing in the dual degree program, the J.D. and MBA degrees will be awarded upon completion of requirements of the dual degree program.

The College of Law will award a maximum of nine (9) semester hours toward the J.D. degree for acceptable performance in approved graduate-level courses offered by the College of Business Administration. Three of the 9 semester hours must be earned in Accounting 501, 503, or a more advanced accounting course.

The College of Business Administration will award credit toward the MBA for acceptable performance in a maximum of 9 semester hours of approved courses offered by the College of Law.

Except while completing the first year courses in the College of Law, students are encouraged to maximize the integrative facets of the dual program by taking courses in both colleges each year.

Awarding of Grades

For grade recording purposes in the College of Law for graduate business courses and in the College of Business Administration for law school courses, grades awarded will be converted to either Satisfactory or No Credit and will not be included in the computation of the student's grade average or class standing in the college where such grades are so converted. The College of Law will award a grade of Satisfactory for a graduate business course in which the student has earned a B or higher and a No Credit for any lower grade. The College of Business Administration will award a grade of Satisfactory for a College of Law course in which the student has earned a 2.3 grade or higher and a No Credit for any lower grade. Grades earned in courses of either college may be used on a regular graded basis for any appropriate purpose in the college offering the course. The official academic record of the student maintained by the Registrar of the University shall show the actual grade assigned by the instructor without conversion.

Non-Law Elective Course Credit

Students enrolled in the J.D.-M.B.A degree program may not receive credit towards the J.D. degree for courses taken in other departments of the University except for those taken in conjunction with the dual degree programs.

Note: Students are advised to consult The Graduate School's degree requirements as stated in the front section of this catalog as well as the requirements for this college.

DUAL J.D.-M.P.A. 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 M.P.A. and J.D. degrees in about four years rather than the five years otherwise 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 J.D.-M.P.A. program must make separate application to, and be independently accepted by, the College of Law for the J.D. degree and the Department of Political Science and The Graduate School for the M.P.A. degree. 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 M.P.A. program. Application may be made prior to or after matriculation in either the J.D. or the M.P.A. program, but application to the dual program must be made prior to entry into the last 28 semester hours required for the J.D. degree and prior to entry into the last 15 hours required for the M.P.A. degree.

Curriculum

A dual degree candidate must satisfy the requirements for both the J.D. and the M.P.A. degrees, as well as the requirements for the dual program. The College of Law will award a maximum of 9 semester hours of credit toward the J.D. degree for successful completion of approved graduate level courses (500 or 600 level) offered in the Department of Political Science. The M.P.A. program will award a maximum of 9 semester hours of credit toward...
the M.P.A. degree for successful completion of approved courses offered in the College of Law. All courses for cross-credit awarded must be approved by the J.D.-M.P.A. 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) and be encouraged to take Local Government (Law 824). An internship is strongly recommended for students in the dual degree program, as it is for all M.P.A. 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 M.P.A. program. During those first two years, students may not take courses in the opposite area without the approval of the J.D.-M.P.A. 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 J.D. or the M.P.A. degree 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 computed in determining a student's GPA. The College of Law will award a grade of Satisfactory for an approved M.P.A. 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 2.0 or higher and a grade of No Credit for any lower grade. The official academic record of the student maintained by the Registrar of the University 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 semester 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/N credit grade only. If a 2.0 or above is earned in a law course, an S will be recorded on the transcript. If a student earns below a 2.0, 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 students must be enrolled in the Dual J.D.-MBA or J.D.-M.P.A. 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 cumulative will be shown on the permanent record.

PROFESSIONAL COURSES
801 Civil Procedure I (3) Binding effect of judgments, selecting proper court (jurisdiction and venue), ascertaining applicable law, and federal and state practice.
803 Contracts I (3) Basic agreement process and legal protections afforded contracts; offer and acceptance, consideration and other bases for enforcing promises; the Statute of Frauds, unconscionability and other controls of promissory liability. Introduction to relevant portions of Article 2 of the Uniform Commercial Code.
804 Contracts II (3) Continuation of Contracts I. Issues arising after contract formation: interpretation, duty of good faith; impossibility and frustration of purpose; remedies; third party beneficiaries; assignment and delegation. Considerable coverage of Article 2 of the Uniform Commercial Code with respect to remedies, anticipatory repudiation, impracticability and good faith.
805 Legal Process I (3) Lawyer-like use of cases and statutes and in prediction and persuasion. Analysis and synthesis of common law decisions; statutory interpretation; fundamentals of expository legal writing and legal research.
806 Legal Process II (3) Continuation of Legal Process I. Formal legal writing, appellate procedure, and oral advocacy.
807 Torts I (3) Intentional torts, including battery, assault, false imprisonment, infliction of emotional distress, conversion and breaching privileges and defenses to intentional torts; negligence, including standard of care and proof of negligence; immunities and limitations on duties; cause in fact, and proximate cause.
808 Torts II (3) Defenses, including contributory negligence, assumption of risk, comparative negligence, and statutes of limitations; vicarious liability; strict liability; nuisance; products liability; settlement; problems of multiple defendants; damages; non- tort alternatives for recovery for personal injury; law reform; defamation, invasion of privacy, and wrongful legal proceedings; misrepresentation, injurious falsehood, misappropriation of commercial vents, and interference with contract; constitutional torts.
809 Criminal Law (3) Substantive aspects of criminal law; general principles applicable to all criminal conduct; specific analysis of particular crimes; defenses to crimes.
810 Property (4) Introductory course treating issues of ownership, possession, and title to the areas of landlord-tenant relations; estates in land and future interests; co-ownership and marital property; real estate sales agreements and conveyances; title assurance and recording statutes; servitudes; and selected aspects of nuisance law, eminent domain and zoning.
812 Constitutional Law I (3) Judicial review, limits on judicial power; national legislative power; regulation of commerce; power to tax and spend; other sources of national power: separation of powers, checks and balances, state taxation and regulation of commerce, intergovernmental immunities.
813 Evidence (4) Rules regulating introduction and exclusion of oral, written and demonstrative evidence at trials and other proceedings, including relevance, competence, impeachment, hearsay, privilege, expert testimony, authentication, and judicial notice.
814 Legal Profession (3) Legal, professional and ethical standards applicable to lawyers.
816 Computer-Assisted Legal Research (3) Introduction to major computerized legal data base retrieval systems. Emphasis on h.w. research productivity throughout year. May be taken beginning spring of first year after completion of first draft of appellate brief in Legal Research II. Must be taken one year prior to end of second year of law study. Prereq: Completion of first draft of appellate brief in 806. S/N only.
818 Income Tax I (4) What is income; whose income is it; when is it income; how is it taxed (capital gains and losses, maximum and minimum tax); deductions and credits; rates (corporate, estate, and trust).
821 Administrative Law (3) Administrative agency decision making processes and judicial review of administrative decisions: procedural standards for informal and formal administrative adjudication and rule-making (attention to Federal Administrative Procedure Act; constitutional issues in process statutes administrative setting; and availability, scope and timing of judicial review of agency actions.
822 Legislation (3) Interpretation and drafting of statutes, legislative process, and legislative power; comparison of judicial views on legislative process with both realities of legislative process and applicable constitutional principles.
824 Local Government (3) Distribution of power between state and local governmental units; sources of authority for limitation on local government operations; creation of local boundaries; home rule; problems created by fragmentation of local government units; financing of local services; influence of federal programs on local government finance and decision-making.
827 Business Associations (4) Legal problems associated with formation, operation, and dissolution of unincorporated and incorporated business enterprises; the rights and duties of firm members (principals and agents; partners and limited partners; and corporate shareholders, directors and officers), and others with whom these members interact in connection with firm's business.
828 Advanced Business Associations (2) Selected topics from law of business associations. Prereq: 827. May be repeated.
830 Securities Regulation (3) Basic structure of federal securities laws. Legal problems associated with raising of capital through debt and equity; securities transactions by promoters, officers, directors and other insiders; regulation of publicly-held companies; litigation under federal securities laws. Prereq: 827.
832 Business Planning Seminar (2) Selected problems on corporate and tax aspects of business planning and transactions. Prereq: 827.
833 Representing Enterprises (3-5) Capstone course for concentration in business transactions. Simulated business transactions and completion of major planning drafting project. Translations vary: formation of new business entity, acquisition of existing business, development of real estate project, various financing transactions and corporate reorganization. Prereq: Completion of all courses for concentration.
834 Antitrust (3) Federal antitrust laws; monopolization, price-fixing, group boycotts, and anticompetitive practices generally; government enforcement techniques and private treble damage suits.
840 Commercial Law (4) Basic coverage of most significant provisions of Uniform Commercial Code; security interests in personal property (Art. 9 of U.C.C. and relevant Bankruptcy Code provisions); commercial paper, including checks, notes and other negotiable instruments (Art. 3 and 4 of U.C.C.); leasing and sales (Art. 2 of U.C.C.), including coverage of portions of Art. 2 of U.C.C. not covered in Contracts.
842 Contract Drafting Seminar (2) Practical fundamentals of drafting contracts of different types.
843 Debtor-Creditor Law (3) Enforcement of judgments; bankruptcy and its alternatives for businesses and consumer debtors, emphasis on Federal Bankruptcy Code.
846 Constitutional Law II (3) First Amendment rights to freedom of religion, expression, association and press;
Leadership Studies

(College of Education)

MAJORS

College Student Personnel ............... M.S.
Education ................................. Ph.D.
Leadership Studies in Education ......... M.S., Ed.S., Ed.D.

Grady Bogue, Leader

Professors:
Bogue, Grady, Ed.D. .......... Memphis State
Harris, G. W., Jr., Ph.D. .......... Michigan
Lovell, J. T. (Emeritus), Ed.D. ..... Florida
McMains, Malcolm C., Ph.D. ...... Florida
Roney, Robert K. (Emeritus), Ed.D., Tennessee
Stollar, Dewey H. (Emeritus), Ph.D.

Trusty, Francis M. (Emeritus), Ed.D. Stanford
Ubben, Gerald C., Ph.D. .............. Minnesota
Vendetti, Fred P. (Emeritus), Ed.D. Northern Colorado

Associate Professors:
Brockett, Ralph G., Ph.D. .......... Syracuse
Connelly, Mary Jane (Laisius), Ed.D. VPI
Husen, Peter M., Ed.D. ............... Stanford
Mertz, Norma T., Ed.D. .............. Columbia

Assistant Professor:
Aper, Jeffrey P., Ph.D. ............... VPI

The Leadership Studies unit offers graduate programs leading to the Master of Science with majors in Leadership Studies in Education, concentrations in adult education and in educational administration and supervision, and College Student Personnel. The Specialist in Education with a major in Leadership Studies in Education, concentration in educational administration and supervision; the Doctor of Education with a major in Leadership Studies in Education, concentrations in adult education, educational administration and supervision, and the Doctor of Philosophy with a major in Education. See Education under Fields of Instruction for full description of all degree requirements.

The higher education doctoral program combines theory and practice in an innovative demonstration of scholarly study and research. A blend of classroom instruction, individualized advising, and supervised practice and internships allows students to develop a specialization in academic administration, community-Junior college administration, student personnel administration, financial administration, and college teaching. For additional information, contact the unit leader.

ADMISSION REQUIREMENTS

General test of the Graduate Record Examination; writing sample if GRE verbal is below 50th percentile; leadership potential judged by activities in organizations; and rating forms or letters of recommendation. The Ed.D. applicant must also interview with all faculty members on campus or elsewhere.

Adult Education

GRADUATE COURSES

509 Internship in Adult Education (3) Practical field experiences in selected settings under supervision of practitioner and departmental representative. Prereq: Consent of instructor. May be repeated. Maximum 6 hrs. E

513 Special Topics in Adult Education (1-3) Specific objectives, activities, and evaluation. Prereq: Consent of instructor. May be repeated. Maximum 9 hrs. E

514 Individual Study in Adult Education (3) Prereq: Consent of supervising instructor. Approval form must be filed in office of unit head. May be repeated. Maximum 6 hrs. E

520 Survey of Adult Education (3) Historical developments, philosophies of adult education agencies, associations, programs, issues, and literature illustrating process of adult education and diversity of continuing education. Prereq: Consent of instructor. F.Su

521 Program Development and Operation in Adult Education (3) Theories and methods from research to practice in planning and operating adult education programs. Prereq: Consent of instructor. F.Su

522 Adult Development (3) Changes in characteristics of adults over life span and implications for adult education. Prereq: Consent of instructor. F.Su

523 Post-Secondary Education for Adults (3) History, evolution, philosophy, structure and functions of post-secondary sub-university institutions, their programs and clientele. Prereq: Consent of instructor. Sp.Su

524 Continuing Professional Education (3) Theories and concepts supporting design and management of educational programs for adults in professions. Prereq: 520 or equivalent. Sp

526 Characteristics of Adult Learners (3) Key characteristics of adult learners, and applications to teaching and learning contexts.

527 Controversies in Adult Education (3) Controversies confronting field of adult education; development of critical analysis skills by looking at controversies from different perspectives.

620 Seminar in Adult Education (3) Issues in adult education, theories and concepts, philosophical positions, research trends and methodologies. Prereq: 510 or equivalent. F.Su

621 Advanced Seminar in Program Planning (3) Conceptual principles, and theories related to program planning in adult education. Prereq: 521 or equivalent. Sp

622 Advanced Seminar in Adult Development (3) Adult development research. Designing research for studies of life cycle. Prereq: 522 or equivalent. Sp.Su

626 Adult Problem Solving and Learning (3) Contemporary research and theoretical perspectives. Adult problem solving and learning. Prereq: 522 or equivalent. F.Su

Educational Administration and Supervision

GRADUATE COURSES

513 Administrative and Organizational Theory in Education (3) Introduction to theoretical administrative and organizational foundations of management and leadership of educational programs and institutions. F.Su

515 Human Relations and Communication in Administration (3) Development and use of effective interpersonal communication skills and techniques, group relations, supportive work climates, personnel motivation, conflict management skills, and role of values, attitudes, and expectations in administration. F.Su

516 Research for School Administrators (3) Descriptive, experimental, and quasi-experimental designs to help students without quantitative backgrounds to read and understand technical professional literature. Intro-
529 Politics of Education and Educational Environments (3) School/community relations in political context of modern, complex society. Administrator and supervisory competencies: political, social, ethnic, cultural, and racial environments in which schools operate. Prereq: M.S. introductory core or consent of instructor. F, Su.

535 Administrative Applications of Micro Computers (3) DOS, word processing, data based management, spread sheets, and computer communications. Review and development of specific administrative applications: scheduling, attendance, student record systems, and accounting. F.

544 School Finance and Business Management (3) For prospective building level administrators. Financial and logical management tasks and procedures in individual school administrative areas. M.S. Introductory core or consent of instructor. F, Su.

547 Educational Facility Planning (3) Concepts and skills for development, evaluation, construction, renovation, maintenance, and operations of quality educational environments. Prereq: M.S. Introductory core or consent of instructor. F, Su.

548 Introductory Supervision and Personnel (3) Basic supervisory and personnel concepts and related competencies; building (or micro-organizational) level interviewing and personnel planning, collecting and maintaining employee information, supervision of instructional and non-instructional personnel, clinical supervision, staff evaluation, and staff development. Prereq: Introductory M.S. core or consent of instructor. F, Su.

553 Strategies of Educational Planning (3) Processes for improving decision-making function through use of both quantitative and qualitative planning techniques. Policy analysis, CPM, PERT, Delphi. Prereq: Introductory M.S. core or consent of instructor. F, Su.

554 School Law (3) Logical arrangement of case and statutory materials for public school administrators and teachers; problems concerning law and public education. Prereq: Introductory M.S. introductory core or consent of instructor. F, Su.

580 Internship in Educational Administration (3) Field experience in appropriate educational setting working directly with administrator. At end of planned program of study. Placement by department assignment. Some on-campus classes in connection with S83 or S85. Prereq: 21 hrs. in educational administration and supervision or consent of instructor. E

582 Educational Leadership and District-Level (3) Role of central administrative team; relationships, behaviors, concepts and competencies for developing and maintaining effective school organization. At end of planned program of study, Prereq: 21 hrs. in educational administration and supervision or consent of instructor. F, Su.

590 Special Topics (1-3) May be repeated. E

592 Field Problems in Educational Administration and Supervision (3) Topic to be assigned. May be repeated. S/N or letter grade. E

595 Elementary Principals Seminar (1-3) For in-service training of elementary school administrators. Development, problems, and trends of elementary schools and management skills of elementary school administrators. Prereq: Presently elementary school administrator or consent of instructor. May be repeated. S/N or letter grade. F, Sp.

596 Middle School Principals Seminar (1-3) For in-service training of middle school administrators. Development, problems, programs, and trends of middle schools and management skills of middle school administrators. Prereq: Presently middle school administrator or consent of instructor. May be repeated. S/N or letter grade. F, Sp.

604 Seminar in Educational Administration and Supervision (1) Current educational issues, problems and research. Required two consecutive semesters during doctoral residency. May be repeated. S/N or letter grade. E

605 Advanced Seminar in Administrative Theory (2) Interdisciplinary seminar. Readings selected by faculty for research and scholarly value from early to current classic theoretical studies and current periodical literature in educational administration. Required of Ph.D.

610 Internship in Educational Administration (3) Opportunity for doctoral students and advanced graduate students to gain experience in performance of critical tasks of educational administration under supervision of practitioners and University personnel. May be repeated at discretion of student's committee. Maximum 12 hrs. S/N or only. E

614 Statistical Methods for School Administrators (3) Descriptive and experimental research methods, parametric and non-parametric statistical techniques used in research in educational settings. F

615 Research Designs (3) Statistical methods through multi-variate techniques and applications to various research designs. Prereq: 614 or consent of instructor. Sp.

616 Research Methods (3) Overview of descriptive and experimental research methods, sampling techniques, and interpretation for survey studies and school surveys. Conduct of survey. Prereq: Basic statistics and computer skills or consent of instructor. E

629 Seminar in Politics of Education (3) Political theories and practices in the role of operation of public school systems and higher education institutions. Interdisciplinary discussions of community power structures and special interests. Based on literature and research from education, sociology, and political science. Field inquiry. Prereq: 529, 616 or equivalent or consent of instructor. F

644 Educational Finance and Business Management (3) Contemporary educational finance policies and their influence upon education, nation and citizens. Supervisory team concept, management of school logistical services. Prereq: 544 or consent of instructor. F, Su.

646 School Personnel Administration (3) Personnel administration functions for professional and supporting staff in educational organizations. Recruitment, selection, placement, personnel policies, employee wage and salary administration, fringe benefits, collective negotiations, human relations, staff development, and staff evaluation. Prereq: 548 or consent of instructor. F, Su.


656 Legal Foundations of Public Education (3) School law; constitutional foundations as they relate to public education at state and local levels. F, Su.

658 Conflict Management (3) Social conflict and its management. Causes of interpersonal, intergroup, and organizational conflict, skills and strategies used to manage conflict, conflict management models associated with different factors of human activity, and current organizational practices for managing destructive conflict. F

670 Values and Ethics in Educational Leadership (3) Examination of moral and ethical dimensions of work of educational administrators; assistance to current and prospective administrators to deal with dimensions in knowledgeable, reflective way and principled ways. (Same as Higher Education 670.)

680 Administration of Complex Organizations (3) Concepts and theoretical formulations to understand, analyze, evaluate, and change complex educational programs and organizations. Prereq: 513 or consent of instructor. Sp, Su.

689 Practicum in College Student Personnel (1-6) Prereq: Consent of instructor. May be repeated. S/N only. E

690 Special Topics (1-3) May be repeated. E

691 Administration and Governance of Higher Education (3) Trends, structure and process of collegiate governance. Development of understanding of administrative theory and practice in higher education. Prereq: 543 or consent of instructor. F

693 Independent Study (1-3) May be repeated. S/N only. E

500 Thesis (1-15) P/NP only. E

502 Registration for Use of Facilities (3-15) Required for the student who wishes to be associated during any semester when used University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/N only. E


518 Educational Specialist Research and Thesis (3) May be repeated. P/NP only. E

593 Independent Study (1-3) May be repeated. S/N or letter grade. E

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

693 Independent Study (1-3) May be repeated. S/N or letter grade. E

543 American Higher Education in Transition (3) History, philosophy, purposes, functions, organizations and programs in American higher education. F

670 Introduction to Student Personnel Work in Higher Education (3) Historical, philosophical and organizational perspective. Functional areas comprising field and major issues. F

572 Theory and Practice in Student Personnel Services (3) Theoretical framework of college student personnel services and practical application of theory in student services environment. Applicable administrative theory and evaluation assessment techniques. Sp.

599 Practicum in College Student Personnel (1-6) Prereq: Consent of instructor. May be repeated. S/N only. E

618 Administration and Governance of Higher Education (3) Trends, structure and process of collegiate governance. Development of understanding of administrative theory and practice in higher education. Prereq: 543 or consent of instructor. F

540 College and University Law (3) Legal precedent affecting organizations, administration, and finance of higher education. Academic freedom, faculty termination, religion, tort liability, administrative law, academic due process and affirmative action in employment. Sp.

645 Curriculum and Instruction in Undergraduate Higher Education (3) Content and organization of institutional strategies and curricular structures in higher education. F.


670 Values and Ethics in Educational Leadership (3) (Same as Educational Administration and Supervision 670.)

695 Practicum in Higher Education (1-6) Supervised practicum in selected areas of higher education administration. Prereq: Consent of instructor. May be repeated. S/N only. E

698 Seminar in Higher Education (3) Analysis of administrative and organizational structure, theory and practice in management of American colleges and universities. Prereq: 543 or consent of instructor. Su.

Leadership Studies

GRADUATE COURSES

500 Thesis (1-15) P/NP only. E

502 Registration for Use of Facilities (3-15) Required for the student who wishes to be associated during any semester when used University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/N only. E


518 Educational Specialist Research and Thesis (3) May be repeated. P/NP only. E

593 Independent Study (1-3) May be repeated. S/N or letter grade. E

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

693 Independent Study (1-3) May be repeated. S/N or letter grade. E

Higher Education

GRADUATE COURSES

530 Special Topics (1-3) May be repeated. E

542 The College Student and the Court (3) Legal precedent affecting student personnel services in public higher education. Student discipline, housing, campus organizations, activities fees, tuition and related federal regulations. F

125
Life Sciences
(College of Arts and Sciences)

MAJOR DEGREES
Life Sciences ......................... M.S., Ph.D.
Howard I. Adler (Liaison), Chair

Coordinating Council:
Becker, Jeff M., Cellular, Molecular and Developmental Biology
Richard S. Saudargas, Ethology
Schwarz, J. O., Plant Physiology and Genetics
Dougall, D. K., Biotechnology
Farkas, W., Human Anatomy & Toxicology
Vaughan, Gerald, Physiology

The programs leading to the M.S. and Ph.D. degrees in Life Sciences are interdepartmental and intercollegial programs which augment the programs of individual departments.

The Life Sciences Council supports studies and research in the following concentrations: physiology; biotechnology (M.S. only); cellular, molecular and developmental biology; environmental toxicology; ethology; and plant physiology and genetics. Students interested in any of these areas should contact either the chair of Life Sciences or the director of the appropriate area of interest. Each program is overseen by a committee and may have unique admission and graduation requirements.

ADMISSION REQUIREMENTS
1. A Bachelor's degree with a major in a biological, behavioral, or physical science.
2. GRE (general) scores.
3. Three letters of recommendation.
4. Coursework including a year of calculus (differential and integral), one year of chemistry, and a year of physics. Specific course deficiencies may be corrected during the first year.

DEGREE REQUIREMENTS
The master's degree requires a minimum of 30 semester hours of study approved by the student's committee, a thesis, and an oral examination. Within the biotechnology program only, a non-thesis M.S. option is available. Students choosing this option are expected to complete: (1) two summers' co-op experience in an appropriate industry. An evaluation by supervisor and a written report are required (529, Biotechnology Practicum Cooperative Experience, maximum 4 hrs.); (2) A written report in the form of a scientific paper in an area of specialization chosen by the student and advisor. The minimum requirements for the doctoral degree include at least 6 hours above the 600 level, 24 semester hours of coursework, a pattern of courses approved by the student's committee, a comprehensive examination, a doctoral dissertation, and a defense of dissertation. Individual programs may have additional requirements.

CONCENTRATIONS
Biotechnology
The biotechnology program will prepare students to participate in the wide variety of opportunities presented by the use of living cells and their components for the production of useful materials. This will be achieved at the M.S. level by a prescribed course of study of the biology and biochemistry of cells and molecules; by formal study of cells and of engineering aspects of biotechnology; and by the development of special expertise in areas such as animal embryo manipulation, automated chemical synthesis of macromolecules, bioprocess engineering, bioproducts and biotransformations, liposomes, microscopy and image processing, monoclonal antibodies and hybridoma technology, plant tissue culture, recombinant DNA technology and risk assessment, and modeling. The production of a research thesis or an industrial co-op experience plus an area of specialization will also be an important part of the training experience.

Required courses are Life Sciences 509, 511, 512, 531, 532; Biochemistry 511; Microbiology 410; Botany 451; Chemical Engineering 475; and Zoology 507.

Cellular, Molecular, and Developmental Biology
The inter-departmental program in cellular, molecular, and developmental biology includes research in structural or functional aspects of cells or subcellular components, or the interactions between cells.

Required courses are Life Sciences 511, 512, 531, and 532.

Environmental Toxicology
The toxicology program provides intensive training in basic toxicological principles and techniques. Courses and research expose trainees to mechanisms of intended and unintended interactions between living systems and potentially toxic agents from the point of view of biochemistry, physiology, ecology, public health, environmental law and regulation, pest management, pollution control and repair, and testing and residue analysis of toxicants.

Required courses are Biochemistry 561, 562, 604; and Life Sciences 610.

Ethology
Ethology is the naturalist study of normally occurring animal and human behavior. The program provides intensive training in basic ethology with specialized studies available in the development, evolution, and physiology of behavior; comparative psychology; human ethology; and behavioral ecology and sociobiology.

Required courses for the master's are Psychology/Zoology 450, 459; Zoology 524, 583; Statistics 531-32; and Zoology/Psychology 516.

The Ph.D. requirements are the same as for the master's with the additional requirements of one additional statistics course and six semester hours of courses numbered above 600 approved by student's committee.

Physiology
The interdepartmental program in physiology includes research in the areas of cellular, comparative, developmental, exercise, muscle, neurophysiology, regulatory, or reproductive.

Required courses are Zoology 520, 521, Human Anatomy, Comparative Vertebrate Biology, 420; Biochemistry 410; four 600-level semesters; and a statistics sequence.

Plant Physiology and Genetics
This program provides the opportunity for intensive training and research experience in areas transcending the usual boundaries of botany, biochemistry, and agricultural plant sciences. It devotes itself to seeking solutions of problems concerning the interactions of physiology and genetics in applied and fundamental aspects of plant science.

Required courses are Life Sciences 510; Botany 521, 522; Biochemistry 511, 512; Plant and Soil Science 471 or Zoology 560; Plant and Soil Science 55; Microbiology 410.

GRADUATE COURSES

500 Thesis (1-15) P/NP only. E
502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/N only. E
509 Biotechnology Seminar (1-2) Topics of importance to biotechnology. May be repeated. Maximum 6 hrs.
510 Special Topics in Life Sciences (1-3) Specializations in biotechnology; cellular, molecular, and developmental biology; environmental toxicology; ethology; plant, physiology and genetics; and physiology. May be repeated. Maximum 9 hrs.
511 Advanced Cellular Biology (3) Cell structures and functions at a molecular and supramolecular level. Membrane structure, function, and biogenesis; cellular communication; receptors and membrane flow; growth regulation and oncogenes; plant cell structure and function; contractility and mobility; mitosis and meiosis; blood and immune cells.
512 Advanced Molecular Biology (4) (Same as Biochemistry 512.)
525 Research Practicum in Life Sciences (1-3) Individual sections for each of biotechnology; cellular, molecular, and developmental biology; environmental toxicology; ethology; plant physiology and genetics; and physiology. May be repeated. Maximum 9 hrs.
529 Biotechnology Practicum Co-operative Experience (2) Work experience in commercial organization for students undertaking non-thesis option of biotechnology concentration. Evaluation by supervisor and written report by student. May be repeated. Maximum 4 hrs.
531 Biotechnology Laboratory (3) Growth of microorganisms, analysis of extracellular and intracellular components.
532 Biotechnology Laboratory (3) Pilot scale yeast cultivation, enzyme isolation, purification and characterization. Application of purified enzymes to food production fermentations and fermentation process control.
600 Doctoral Research and Dissertation (3-15) P/NP only. E
610 Advanced Topics in Life Sciences (1-3) Topics vary. May be repeated. Maximum 6 hrs.

Logistics
See Marketing, Logistics and Transportation

Management
(College of Business Administration)

MAJOR DEGREES
Business Administration .................. MBA, Ph.D.
Oscar Fowler, Head

Professors:
Boling, Ronald W. (Emeritus), Ph.D. ; Stanford Deweese, H. Dudley, Ph.D. ; Texas Dobbins, Gregory H., Ph.D. ; VPI

126 Life Sciences
GRADUATE COURSES

students an opportunity to develop an interdisciplinary specialization in environmental policy. See Economics for program description.

GRADUATE COURSES

500 Thesis (1-15) P/NP only. E

502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NP only. E

504 Management of Organizational Behavior (3) Integration of individual and group differences, organization theory and design, motivation, leadership, human resource planning, and career implications with strategy, planning, and decision making.

511 Organizational Theory: Integrated Structure and Behavior (3) Cases, group projects, discussion; organizational theories, organizational effectiveness; contextual factors of organizations: environment, size, technology; organizational structure configurations, organization design; social influences on organization effectiveness; motivation, leadership, group behavior, intergroup relations, organizational change and development.

521 Personnel Administration (3) Personnel functions and human resources management. Community relations, recruiting, selection, training, performance evaluation, wage and salary administration, legal framework as it affects personnel.

522 Labor Relations and Collective Bargaining (3) American labor history, structure and philosophy of bargaining, dispute settlement, and contract administration. (Same as Economics 562.)

525-26 Industrial and Organizational Psychology (1-3-1-3) Readings in industrial and organizational psychology. Available only by prearrangement with supervising faculty member. May be repeated. Maximum 6 hrs. S/NP or letter grade.

531 Management of Technology-Based Organizations (3) Role of technology and innovation in formulation and implementation of strategy. Management of research and development function and coordination with other functions. Management of scientists and engineers.

541 Operations Management I (3) Techniques applicable to design of systems in operations function.

542 Operations Management II (3) Operations planning and control function. Application of models to real-world systems.

551 Management of New Ventures (3) Integration of various functional disciplines and their application to general management of ventures formed both within larger corporations and independently. Preparation of a venture plan, case analysis.

567-68 Proseminar in Industrial/Organizational Psychology (1-3) Readings in industrial and organizational psychology. Must be taken in sequence during student’s first year of study in industrial and organizational psychology program. Consent of instructor required for all non-industrial/organizational psychology program students. (Same as Psychology 517-18.)

571 International Management (3) Analysis of international business firms and impact of internal and external factors on managerial decisions.

581 Environmental Management (3) Managerial frameworks for addressing environmental issues. Most pressing environmental challenges; options compatible with sustained business performance. Cases, field projects, research papers.

593 Directed Independent Study (1-3) Topic of mutual interest. Available only by prearrangement with supervising faculty member. May be repeated. Maximum 6 hrs. S/NP or letter grade.

595 Selected Topics in Current Management Issues (1-3) In-depth consideration of current issues. May be repeated. Maximum 6 hrs. S/NP or letter grade.

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

601 Research Methods (3) Seminar covering broad range of issues: research process as applied to study of management, literature and examples of research. Research proposal.

610 Seminar in Advanced Organization Theory (3) Analysis of functioning of complex organizations. Classical and open systems models, organization growth and change, organizational effectiveness and design of complex organizations.


612 Seminar in Strategic Management II (3) Analysis of concepts and research in strategic management.

613 Seminar in Strategic Management III (3) Review and analysis of important books and monographs in strategic management. Understanding evolution of thought and emergence of distinct paradigms.

625 Seminar in Organizational Psychology (3) In-depth analysis of current theories, concepts, and issues associated with psychology of organizational leadership and work motivation. Prereq: 567, 568, consent of instructor. May be repeated. (Same as Psychology 625.)

626 Seminar in Industrial Psychology (3) In-depth analysis of various topics: organizational change and development, psychological and personal characteristics, motivation, incentives, employee selection. Prereq: 567, 568, consent of instructor. May be repeated. (Same as Psychology 626.)

631 Seminar in Applied Industrial Psychology (3) In-depth analysis of current issues. Prereq: 567, 568, consent of instructor. May be repeated. (Same as Psychology 631.)

690 Field Work in Industrial and Organizational Psychology (1-12) Supervised field practice in industrial and organizational psychology. 1 hr per 30 hrs of practice. May be repeated. Maximum 12 hrs. (Same as Psychology 690.)

Management Science

(Official of Business Administration)

MAJORS

Management Science M.S., Ph.D.

Business Administration MBA

Charles E. Noon, Chairperson

Committee Members:

Bowers, Melissa R., Management; Bozdogan, Hamparsum, Statistics; Edirisinghe, Chanakya F., Management; Fowler, Oscar S., Management; Gilbert, Kenneth C., Management; Leitlaker, Mary G., Statistics; Noon, Charles E., Management; Raistin, Bruce A., Geography; Srivivasan, M. M., Management.

THE MASTER’S PROGRAM

The M.S. program in Management Science is designed as preparation for a career in the application of quantitative techniques for the solution of complex problems. The program’s flexibility also makes it appropriate as preparation for doctoral study in Management Science.

Management Science coursework will expose students to both the theoretical development of quantitative techniques and their application to managerial decision making. In addition to the development of sufficient mathematical maturity for creative use of quantitative skills, the program requires concentrated study in a supporting area.
Supporting areas are available in other departments of the College of Business Administration (excluding statistics) as well as in computer science, public administration, ecology, and other areas, subject to approval by the Management Science Committee.

Admissions Requirements
The master's program requires three applicant recommendation forms and the GRE or GMAT. Applications are encouraged from all majors, but mathematics background equivalent of the completion of at least two years of college calculus and proficiency in a computer language is required. The program is designed to be completed in three semesters by full-time students. However, students may start the program in any semester and may pursue an M.S. degree in Management Science on a part-time basis.

Course Requirements

<table>
<thead>
<tr>
<th>Course Requirements</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Requirements</td>
<td>14</td>
</tr>
<tr>
<td>Management Science 531, 532, 533, 534</td>
<td>4</td>
</tr>
<tr>
<td>Statistics 563</td>
<td>3</td>
</tr>
<tr>
<td>Applied specialization area (approved by advisor)</td>
<td>9</td>
</tr>
<tr>
<td>Statistics elective—500 level or above (approved by advisor)</td>
<td>6</td>
</tr>
<tr>
<td>Mathematics—400 level or above (approved by advisor)</td>
<td>9</td>
</tr>
<tr>
<td>Electives selected from mathematics, statistics, computer science, and/or management science area</td>
<td>38</td>
</tr>
</tbody>
</table>

A thesis option is available to qualified students which substitutes 6 hours of thesis credit for the following 9 hours of course work: Management Science 534, 3 hours in the applied concentration area and 9 hours of electives in any area. The Management Science Committee will work closely with the student in tailoring a program to his/her needs. The committee must approve a tentative overall program during the student's first semester and must approve all course offerings for the semester. The student must complete 12 to 14 semester hours of electives in mathematics, statistics, and computer science.

Recognizing the diverse backgrounds and needs of Management Science M.S. students, the Management Science Committee is prepared to waive some of the above requirements on an individual basis. For example, an undergraduate mathematics major with a strong background may be allowed to take 6 additional hours of electives in place of the mathematics requirements. On the other hand, a student lacking experience in rigorous senior-level mathematics courses will be asked to take such courses to fulfill the 6-hour mathematics requirement. The total course load will remain 38 hours for all non-thesis students and 36 hours for all thesis students; however, the number of hours of electives can be reasonably expected to vary between 6 and 12 as a function of prior background.

The doctoral program requires three applicant recommendation forms and the GRE or GMAT, in addition to the Graduate School's requirements.

Coursework
A minimum of 48 semester hours of coursework taken for graduate credit (exclusive of thesis or dissertation) is required. Some of this may be coursework from a master's program although a master's is not a prerequisite for the doctorate. The candidate must complete a minimum of 24 semester hours at The University of Tennessee, Knoxville, at least 6 of which must be at the 600 level. Both of these requirements are also exclusive of dissertation credits. Entering students who have completed graduate studies in applicable fields will be granted course credits for work which is equivalent to required courses in the program.

The program includes approximately 16 to 20 semester hours of coursework in the applied area.

Qualifying Examinations
The student must demonstrate mastery of probability theory and statistical inference, Statistics 563, 564, by passing a written qualifying examination. Mastery of 12 to 14 semester hours in mathematics coursework must be demonstrated by passing a written qualifying examination. Topics normally include numerical analysis, either Mathematics 471, 472, 453, and 571, or 571-572, and real analysis, Mathematics 445-446. Other options may be approved. In exceptional circumstances, the faculty will consider waiving the mathematics or statistics qualifying examinations.

These requirements generally are completed by the end of the first year of the program. There is no foreign language requirement.

Comprehensive Examination
Prior to admission to candidacy for the degree, and normally after completion of the second year of the program, the student must pass a written comprehensive examination covering the theory of deterministic and stochastic management science models. Topics included in this examination are determined on an individual basis. Students will be expected to demonstrate an integrative ability that goes beyond simple mastery of course content.

Research and Dissertation
The student must complete 24 semester hours of Management Science 600: Doctoral Research and Dissertation, through which he/she is expected to make a significant contribution to the science. A final oral examination is conducted over the dissertation and such other segments of the program that the faculty deems appropriate. This effort, which is beyond the minimum 48 hours of coursework, normally is completed in the third year of the program.

ACADEMIC STANDARDS
A graduate student in the College of Business Administration whose grade-point average falls below 3.0 will be placed on probation. A student on probation will be dropped from the program unless his/her cumulative graduate grade-point average is 3.0 or higher at the end of the probationary period. The probationary period is defined as the next semester's coursework as established by the degree program for full-time students and the next two semester's coursework as established by the degree program for part-time students.

PREREQUISITES FOR MANAGEMENT SCIENCE COURSES
The Management Science Program is interdisciplinary and students in other degree programs are encouraged to enroll in management science courses. Course prerequisites are designed to indicate the level at which courses are taught. Interested students whose prior coursework does not match the prerequisites are encouraged to seek the instructor's guidance and consent to enroll.

BUSINESS ADMINISTRATION CONCENTRATION
For complete listing of MBA program requirements, see Business Administration.

MBA Concentration: Management Science. Minimum course requirements are 531, 532 and 534.

GRADUATE COURSES

500 Thesis (1-15) P/NP only, E
502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. SNC only, E
531 Mathematical Programming (3) Linear programming procedures, duality and sensitivity analysis, network flows, integer, and nonlinear programming. Prereq: Fundamentals of matrix algebra and differential calculus, proficiency in computer language. F
532 Stochastic Models in Management Science (3) Discrete-time Markov chains, Poisson processes, continuous-time Markov chains, renewal theory, queueing theory. Prereq: Statistics 563 and Mathematical Analysis or consent of instructor. Sp
533 Computational Mathematical Programming (3) Advanced modeling, computational and reporting techniques in practical mathematical programming. Prereq: 531 and proficiency in PASCAL.
534 Application of Management Science Methods (3) Application of methods from 531 and 532 to real-world problems. Exposure to existing problem in industry or elsewhere. F
581 Special Topics in Management Science (3) Prereq: Consent of instructor. May be repeated. Maximum 9 hrs.
BUSINESS ADMINISTRATION CONCENTRATIONS

For complete listing of MBA and Ph.D. program requirements, see Business Administration.

MBA Concentration: Logistics and Transportation, Marketing.

Minimum course requirements for logistics and transportation—501, 508, and one course from the following: 504, 506, 507, 593, and 599.

Ph.D. Concentration: Logistics and Transportation, Marketing.

Minimum course requirements for logistics and transportation—12 hours to include 601, 602, 603. For marketing—12 hours from among the following courses: 601, 602, 603, 604, 605, 606.

Marketing

GRADUATE COURSES

502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.

503 Buyer Behavior—Analysis for Marketing (3) Consumer behavior concepts and processes developed and applied to market analysis and design, and control of marketing programs. Social psychology and demographic factors affecting consumer product, brand and patronage decisions. PreReq: Business Administration 504 and 505 or consent of instructor.

504 Analyzing Market Opportunity for Marketing Decisions (3) Major determinants of opportunity in markets, framework for finding markets and analyzing them for opportunity, application of market opportunity analysis to marketing strategy decisions. PreReq: Business Administration 504 and 505 or consent of instructor.

505 Marketing Research and Information Planning (3) Design of a rigorous marketing study from inception to implementation of results by recognizing key decision points and critically evaluating merit of research project. PreReq: Business Administration 504 and 505 or consent of instructor.

506 Marketing Strategy (3) Integration of concepts and analytical skills from each component area of marketing to formulate cohesive, well-organized marketing program. PreReq: Business Administration 504 and 505 or consent of instructor.

510 Principles of Marketing Management for Non-MBA Students (3) Students from other disciplines interested in obtaining knowledge of marketing discipline at graduate level.

511 MBA Marketing Concentration (6) Determination of customer value. Principles of consumer behavior, marketing research, and building customer value. PreReq: Business Administration 504 and 505 or consent of instructor.

512 MBA Marketing Concentration II (6) Delivery of customer value. Communication of customer value, marketing strategy, and providing customer responsive organizations. PreReq: Business Administration 504 and 505 or consent of instructor.

550 Market Opportunity Analysis for New Ventures (3) Concepts for understanding coverage of new venture MCA and various information sources and procedures; identify and analyze sales opportunities in markets for new product or service. PreReq: Consent of instructor.

593 Independent Study (3) Directed research and study. PreReq: MBA Core and consent of instructor. May be repeated. Maximum 8 hrs.

599 Special Topics Seminar (3) Topics vary; nonbusiness marketing applications, macroenvironmental issues, market segmentation, international marketing, services marketing, marketing channels, and related issues. PreReq: Consent of instructor. May be repeated. Maximum 8 hrs.

Logistics and Transportation

GRADUATE COURSES

501 Survey of Logistics and Transportation (3) U.S. logistics and transportation: physical, economic, social, and political environments, financing, managing, and enhancing U.S. transport infrastructure.

502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.

504 Freight Carrier Systems and Management (3) Analysis of freight carrier management’s efforts to provide services demanded by consumers in logistics and transportation marketplace.

506 Logistics Systems Management (3) Development of strategy for management of logistics systems. Executive level integration of logistics operations with marketing, production, and other decision areas. Practical applications through case approach and simulation game.

507 International Logistics and Transportation (3) Logistics strategy in the multi-national firm: materials management, international sources and distribution, and importing/exporting; issues: international carrier management and operations and comparative national transport systems analysis.

508 Executive-In-Residence Seminar in Logistics and Transportation Strategy (3) Capstone, integrative case course in logistics and transportation strategy: participation in Executive-In-Residence program that provides student interaction with top-level logistics and transportation executives.

593 Independent Study (3-6) Directed research and study. PreReq: Consent of instructor. May be repeated.

599 Special Topics in Logistics and Transportation (3-6) Seminar designed to study specific current problem areas in logistics and transportation. Topic announced prior to offering. PreReq: Consent of instructor. May be repeated.

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

601 Seminar in Logistics and Transportation Models (3) Analysis of contemporary models and methodologies.
in logistics and transportation research, topical coverage at discretion of instructor.

602 Seminar in Evolution of Logistics Thought (3) Traces evolution of logistics and transportation thought: dynamic development of principles and tools developed as organizational missions and environmental change. Economic and policy issues peculiar to transportation and other service organizations.

603 Research Methodology in Logistics and Transportation (3) Various research methods used in logistics and transportation. History and development of body of knowledge. Review of literature. Discussion of contemporary research issues. Development of student's dissertation research proposal.

Materials Science and Engineering
(130)

MAJORS DEGREES
Metallurgical Engineering M.S., Ph.D.
Polymer Engineering M.S., Ph.D.

Joseph E. Spriuill, Head

Professors:
Bogue, Donald C., Ph.D. Delaware
Borie, Bernard S., Ph.D. MIT
Brooks, C. R., Ph.D. Tennessee
Buchanan, Raymond A., Ph.D. Vanderbilt
Clark, Edward S., Ph.D. California
Fellers, J. F., Ph.D. Akron
Liew, P. K., Ph.D. Northwestern
Loundes, Douglas H., Ph.D. Colorado
Lundin, Carl D., Ph.D. Rensselaer
Ollier, Ben F., Ph.D. Penn State
Pedraza, A. J., Ph.D. National (Argentina)
Phillips, Paul J., Ph.D. Liverpool (UK)
Spriuill, Joseph E. (Liaison), Ph.D. Pennsylvania
Stansbury, E. E. (Emeritus), Ph.D. Cincinnati

Associate Professors:
Becker, William T., Ph.D. Illinois
Benson, R. S., Ph.D. Florida State
Meek, Thomas T., Ph.D. Ohio State

Graduate programs are offered leading to the degrees of Master of Science and Doctor of Philosophy in Metallurgical or Polymer Engineering. Both the metallurgical and polymer programs are flexible and interdisciplinary in nature. Students may be admitted from a wide range of disciplines; these include physics, chemistry, chemical engineering, mechanical engineering, electrical engineering, materials engineering, and engineering science programs. Prospective students should consult materials science and engineering faculty concerning development of individual concentrations or special programs compatible with their backgrounds and goals.

Areas of concentration within the metallurgical engineering program include physical metallurgy; materials processing; welding metallurgy and materials joining; corrosion behavior; failure analysis; and mechanical and physical behavior of materials. Specializations in electronic and ceramic materials are available.

Areas of concentration within the polymer engineering program include rheology and polymer processing; polymer morphology; mechanical, physical and chemical behavior of polymers, and composite materials.

THE MASTER’S PROGRAM

Thesis Option

A total of 30 semester hours is required for the M.S. degree in either Metallurgical Engineering or Polymer Engineering. Additional requirements include:

1. A major consisting of 12 to 18 semester hours of graduate courses in metallurgical engineering or polymer engineering. The polymer engineering major must include 540, 541, 543, 546, 549, 550 and 572 unless similar material has been covered in prior coursework.

2. Additional courses amounting to 6 to 12 hours total in any approved engineering, chemistry, mathematics, physics, or other related fields.

3. Master’s thesis, 500 totaling 6 to 12 hours. All resident students are required to register for and participate in the graduate seminar in metallurgical engineering or polymer engineering, as appropriate, during each semester in which it is offered. Credits for the seminar do not count towards satisfying the coursework requirements.

Non-Thesis Option

Under certain conditions, a candidate may apply for a non-thesis option. To be eligible, the candidate must show evidence of significant professional experience after the baccalaureate degree; at least five years of industrial experience or research publications would be examples of such evidence. A departmental faculty meeting will consider each application individually. A supervisory committee of three will be appointed, at least two being from the Department of Materials Science and Engineering. The requirements for completion of the non-thesis option are as follows:

1. A total of at least 33 hours in graduate courses in metallurgical engineering, polymer engineering and related areas. The minimum requirement is 21 hours in the Department of Materials Science and Engineering and up to 12 hours in other engineering or science courses. The candidate’s degree program must be approved by the faculty committee.

2. Satisfactory completion of a critical review of the literature in an area related to metallurgical, polymer or materials engineering (560).

3. Satisfactory performance in an oral examination to be conducted by the faculty committee and covering the written paper and other areas of metallurgical or polymer engineering.

THE DOCTORAL PROGRAM

Students applying for entrance into the doctoral program must display concrete evidence of ability to perform and report independent research to the satisfaction of the department. The master’s thesis may be offered as such evidence.

Department requirements consist of the satisfactory completion of:

1. Graduate courses in materials science and engineering amounting to approximately 24 semester hours, at least 8 of which must be in 600 series courses.

2. Supporting courses in related scientific and engineering fields amounting to approximately 24 semester hours, subject to approval by the student’s faculty committee.

related fields will normally include chemistry, mathematics, physics, and engineering.

3. The comprehensive examination, usually given in two parts, and covering such topics as materials science and engineering, metallurgical or polymer engineering operations and processes, thermodynamics, technology, mathematics, physics, chemistry, and other related fields.

4. Active participation in graduate seminars conducted by the department. Resident students must register for the appropriate 503 or 504 every semester offered.

ACADEMIC COMMON MARKET

An agreement among southern states for sharing graduate programs allows legal residents of some states to enroll in certain programs at UT Knoxville on an in-state tuition basis. The Ph.D. program in Metallurgical Engineering is available to residents of the state of Virginia; the M.S. and Ph.D. programs in Polymer Engineering are available to residents of Arkansas, Kentucky, Louisiana, or Virginia. Additional information may be obtained from the Admissions Specialist in the Office of Graduate Admissions and Records.

GRADUATE COURSES

405 Structural Characterization of Materials (4) X-ray diffraction and fluorescence; scanning and transmission electron microscopy; microanalytical techniques.

421 Mechanical Behavior of Materials II (3) Description of stress and strain; linear elastic constitutive equations; isotropic and anisotropic models in various materials; yield criteria; brittle fracture; crazing; plastic strain constitutive equations, forming and limit criteria. Prereq: Mechanical Behavior of Materials, Metallurgy and Materials Joining or Polymer Engineering Operations and Processes, Thermodynamics, Technology, Mathematics, Physics, Chemistry, and Other Related Fields.

426 Materials Joining (3) Processes for joining metals, polymers and ceramics: mechanical, adhesive, fusion, solidification/crystallization; surface characteristics necessary for joining and chemical bonding; thermal effects on structure and properties of joints; design of joints. Prereq: Introduction to Materials Science and Engineering.

443 Polymer Processing (3) Rheological measurements; flow through tubes and pipes, and effects and extrudate swell; die design, melt extrusion, injection molding, synthetic fibers, spinning methods, structure development, properties.

444 Plastics Fabrication and Design (3) Lectures, laboratories and field trips; unit operations of plastics fabrication; plastics classification, design and selection criteria, processing techniques, characterization laboratory.


472 Fundamental Principles of Composite Materials (3) Establishment of physical principles basic to design, manufacture and application of fiber reinforced polymers, metals and ceramics. Prereq: 302 or equivalent.

474 Biomaterials (3) Metals, polymers and ceramics used in orthopaedic, cardiovascular, and dental surgical implant devices; corrosion and degradation problems; material properties of primary importance; tissue response to synthetic materials. Prereq: 201. Recommended for engineering science and mechanics majors.

475 Fracture-Safe Design (3) (Same as Engineering Science and Mechanics 423.)
500 Thesis (1-15) P/NP only. E
502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only. E
503 Graduate Seminar in Metallurgical Engineering (1) Prereq: Admission to graduate program. May be repeated. S/NC only. E
504 Graduate Seminar in Polymer Engineering (1) Prereq: Admission to graduate program. May be repeated. S/NC only. E
505 Engineering Analysis (3) Same as Chemical Engineering 505E.
522 Defects in Crystals (3) Analytical and experimental analysis of defect interactions in solids. Prereq: 421 or consent of instructor.
523 Plastic Deformation of Metals (3) Geometry and mechanisms of single crystal plastic deformation; slip, twinning, and cleavage, work hardening, effect of temperature, loading rate effects; effect of ordering and solid solution alloying; polycrystalline behavior in terms of single crystal deformation mechanisms; texture formation. Prereq: 301, 320 or consent of instructor.
524 Metallic Thermodynamics (3) Applications of chemical thermodynamics to metallurgical problems: refining, oxidation, surface treatments, alloy systems. Prereq: 570 or equivalent.
525-26 Welding Metallurgy (3,3) Welding processes; physical metallurgy of welding; phase transformations; heat flow; residual stresses; theories of hot cracking, cold cracking and porosity formation; applications to process utilization.
529 Diffusion in Solids (3) Phenomenology and atomic mechanisms of diffusion in solid state; Solution and applications of diffusion equations; random walk problem and mechanisms of diffusion; diffusion in dilute and concentrated alloys; Kikuchi effect; high diffusion paths.
530 Phase Transformations in Metallic Materials (3) Thermodynamics of phase equilibrium: theory of nucleation in solids; kinetics and morphology of diffusion controlled growth; kinetics of interfaces controlled phase transformations; crystallography and kinetics of martensitic transformations.
531 Advanced Corrosion (3) Analysis of corrosion processes in terms of polarization measurements and Pourbaix diagrams; influence of environment and mechanical factors contributing to pitting, crevice, fretting, wear, fatigue and stress corrosion. Prereq: 470 or consent of instructor.
540 Basic Polymer Chemistry (3) Synthesis, reactions and degradation of polymers; molecular characterization; solution methods and spectroscopy. Prereq: Semester of organic chemistry and thermodynamics or equivalent.
541 Fluid Mechanics and Polymer Processing (3) Navier-Stokes equations and illustrative problems; applications of conservation of energy and momentum, stress, strain rate, mass conservation and momentum, explanation and properties of non-Newtonian flows.
542 Further Topics in Polymer Processing (3) Description and analysis of selected polymer processing operations. Prereq: 541.
544 Polymer Solution Thermodynamics and Characterization (3) Theories of solutions, statistical thermodynamics. Characterization, treatment of chromatography, viscosity, light scattering and osmotic pressure. Prereq: Undergraduate physical chemistry.
546 Mechanical Properties of Solid Polymers (3) Types of mechanical behavior: Hookean and rubber elasticity; plastic deformation; fracture; linear viscoelasticity; dynamic mechanical behavior and testing, loss tangent; experimental methods. Introduction to mechanical properties of polymeric composites.
549-50 Laboratory Methods in Polymer Processing (1,1) Basic experimental techniques and instrumentation associated with characterization of macromolecules, x-ray and light scattering, calorimetry, rheometry, mechanical properties of solid polymers, polymer processing operations. Coreq: 560 or consent of instructor.
560 Principles of Ceramic Processing (3) Treatment of ceramic processing, raw material preparation and characterization: powder consolidation; drying, firing, sintering techniques, mechanisms and kinetics. Prereq: 560 or equivalent.
561 Inorganic Glass Forming Systems (3) Physical and chemical nature of inorganic glasses; structural theories of glass formation; major glass forming systems; silica, other oxide glasses, nitrate glasses, water glasses, and chalcedonides glasses. Prereq: 360, Chemistry 371.
571 Electron Microscopy (3) Operation of electron microscope; kinematics and dynamic deformation theories; structure determination; analysis of defects and defects. Prereq: 304 or equivalent.
572 X-Ray Diffraction (3) Symmetry of crystals, space group theory, reciprocal lattice and application to definition of structures; measurement of single crystal x-ray techniques; introduction to crystal structure determination; characterization of orientation; application to inorganic, metallic and polymer structures.
573 Biomaterials Analysis and Development (3) Physico-chemical properties of new materials and materials for biomedical applications; formation and determination of kinetic pathways. Prereq: 470, 474 or consent of instructor.
574 Formability of Materials (3) Modeling and analysis of size plastic strain with application to primary and secondary forming processes; crystalline and noncrystalline materials; flow localization, instability, predictive testing. Prereq: Consent of instructor.
576-77 Special Topics in Materials Science and Engineering (3,3) Topic of current interest. Prereq: Consent of instructor. May be repeated.
580 Technical Review and Assessment (3) Preparation of critical review literature in area related to materials science and engineering; may be taken by students in non-thesis option. Prereq: Consent of faculty committee.
600 Doctoral Research and Dissertation (3-15) P/NP only. E
621-22 Theoretical Metallurgy (3,3) Topics in solid state physics as applied to metallurgy: introduction to quantum theory, specific heat, electron theory of solids, electrical and thermal conductivity, magnetic properties, theories of alloy formation. Prereq: Consent of instructor.
623-24 Solidification and Crystal Growth (3,3) Theories of solidification, fluid flow effects, magnetohydrodynamics of incompressible fluids, growth rate theory, thermodynamics, applications, rapid solidification theory, metastability. Prereq: Consent of instructor.
641 Advanced Rheology and Viscoelasticity Theory (3) Continuum mechanics, formulation of viscoelastic theories for describing deformation and flow of polymeric materials. Application to polymer processing problems. Recommended for MS candidates working in rheological areas. Prereq: 641.
642 Advanced Topics in Polymer Processing (3) Application of theories of rheological behavior and of structure development to analysis of polymer processing operations. Prereq: 541. (Same as Chemical Engineering 642.)
643 Phase Transformations in Polymers (3) Glass transition and glassy state; annealing of polymeric glasses: crystallization of polymers; nucleation, growth and morphology: secondary nucleation theory; solidification of copolymers; crystallization under stress. Prereq: 543.
671 Quantitative Microscopy (3) Principal acoustic, optical, x-ray, neutron, electron and field-ion techniques for examination of microstructures of materials. Prereq: 405.
676 Advanced Topics in Materials Science and Engineering (3) Latest developments and/or advanced special topics. Prereq: Consent of instructor. May be repeated.
678 Seminar in Recent Advances in Materials Science and Engineering (3) Directed and independent study of advanced topics. Prereq: Consent of instructor. May be repeated.

Mathematics

Mathematics (College of Arts and Sciences)

MAJOR

DEGREES

Mathematics ................................. M.M., M.S., Ph.D.
John B. Conway, Head

Professors:
Alexiades, V., Ph.D. .......................... Delaware
Alikakos, N., Ph.D. .............................. Brown
Anderson, D. T., Ph.D. .......................... Chicago
Baker, G. A., Ph.D. .............................. Cornell
Bradley, John S. (Emeritus), Ph.D. .............. Iowa
Carruth, J. H., Ph.D. ............................. Louisiana State
Clark, C. E., Ph.D. ............................... Louisiana State
Conway, J. B., Ph.D. .............................. Louisiana State
Daverman, Robert J., Ph.D. .......................... Wisconsin
Dessart, Donald J., Ph.D. .......................... Maryland
Dobbs, D. E., Ph.D. .............................. Cornell
Dyda, J., Ph.D. ............................... Warsaw
Frandsen, Henry, Ph.D. .......................... Illinois
Gross, L. J., Ph.D. ............................... Cornell
Hallam, T. G., Ph.D. .............................. Missouri
Hinton, D. B., Ph.D. .............................. Tennessee
Husch, L. S., Ph.D. ............................... Florida State
Johannson, K., Ph.D. .............................. Bielefeld
Jordan, G. Samuel, Ph.D. .......................... Wisconsin
Karakashian, O., Ph.D. ............................ Harvard
Kipershmidt, B. A. (UTSI), Ph.D. ................. MIT
Lenhart, S., Ph.D. ............................... Kentuckv
McConnell, R. M., Ph.D. .......................... Duke
Mathews, H. T., Ph.D. ............................ Tulane
Miller, D. D. (Emeritus), Ph.D. .......................... Michigan
Rajput, B. S., Ph.D. ............................... Illinois
Reddy, K. C. (UTSI), Ph.D. ........................... Indian IT
Rosinski, J., Ph.D. ............................... Michigan
Schaefer, P. W., Ph.D. ............................. Maryland
Sarbin, Steve, Ph.D. .............................. Cornell
Simpson, H., Ph.D. ............................... Cal Tech
Son, K., Ph.D. ............................... Oregon State
Soni, R. P., Ph.D. ............................... Oregon State
Stallman, F. W. (Emeritus), Ph.D. ................. Wisconsin
Stephenson, K. R., Ph.D. .......................... Wisconsin
Sundberg, C. Ph.D. ............................... Wisconsin
Thistlethwaite, M. B., Ph.D. .......................... Manchester
Wade, W. R. Jr., Ph.D. .............................. California (Riverside)
Wagner, C. G., Ph.D. .............................. Duke

Associate Professors:
Kimbale, K. R. (UTSI), Ph.D. .......................... Ohio State
Kuo, Y., Ph.D. ............................... Cincinnati
Muly, S., Ph.D. ............................... Purdue
Richter, Stefan (Liaison), Ph.D. .......................... Michigan
Row, W. H., Jr., Ph.D. .............................. Wisconsin
Smith, J., Ph.D. ............................... California
THE MASTER OF MATHEMATICS PROGRAM

Before admission to the Master of Mathematics program, the applicant must have either (a) certification for teaching secondary mathematics in at least one state, or (b) three years of elementary school, secondary school, or community college teaching experience. Applicants must have successfully completed one year of calculus (141-42 or equivalent) and a course in matrix algebra (251 or equivalent).

The following requirements must be met:

1. Complete 30 hours of coursework of which 21 must be at the 500 level. The coursework must include 504, 505, 506, 507, and 6 hours in 599. At least, 6 hours may be taken outside the Department of Mathematics (selected in consultation with the advisor).

2. Pass a final examination upon completion of all coursework.

In exceptional circumstances, part of admission requirement (b) might be satisfied concurrently with coursework. Normally Master of Mathematics degree students will start the program by taking 504 during the summer.

THE MASTER OF SCIENCE PROGRAM

The department offers two options for the Master of Science degree. The first option requires a thesis for which 6 hours must be earned along with an additional 24 hours of work in acceptable courses numbered above 400. Of the additional hours, 6 may be in an area outside the department and 15 must be in courses in mathematics numbered above 500.

After one semester of graduate study, a student whose advisory committee gives its approval may choose the non-thesis option, for which 30 hours in courses numbered above 400 are required. Of these 30 hours (at least 15 of which must be in mathematics) must be in courses numbered above 500. Of the 30 hours, 9 in courses approved by the advisory committee may be taken in fields other than mathematics. For this option it is also required that a written final examination be passed and that credit be received for a reading course (598) in which a term paper or project is required.

THE DOCTORAL PROGRAM

For the Ph.D. program in Mathematics, the student must meet the following four requirements in addition to those of the Graduate School:

1. Satisfy either the standard program or the interdisciplinary mathematical ecology concentration. A student intending to work in mathematical ecology may complete the standard program or interdisciplinary mathematical ecology concentration. A student may elect to switch from one to the other provided the course work and other option have not been violated. A student's status after electing such transfer is determined by the complete history of the student's earlier mathematics examinations from the standard program and the interdisciplinary mathematical ecology concentration. Descriptions of both programs are given below.

2. Demonstrate proficiency in one foreign language, normally French, German or Russian. This requirement must be met prior to the examination in the area of specialization. A student's doctoral committee may require the student to pass a second language examination.

3. Pass an examination in the field of specialization. After the requirements in 1. and 2. have been met, this examination will be given by a committee appointed by the department head. A student may take this specialty examination only twice.

4. Pass a one-year, 600-level sequence in mathematics outside the student's area of specialization. The sequences selected to fulfill this requirement must be approved by the department head and the student's doctoral committee. (Such approval may occur after completion of the sequence.) Requirements 1-4 must be completed no later than the start of a student's seventh year (as a mathematics graduate student at UT Knoxville).

Standard Program

Demonstrate knowledge in five subjects selected from the groups listed below by passing written examinations in three subjects and by earning grades of B+ or better each semester in the courses associated with two additional subjects. The three subjects selected for written examinations must be from Groups I, II, III, and at least two groups must be represented in the three written examinations. At least three groups must be represented in the five subjects.


A student's five subjects may not include both Real Analysis and Applied Linear Analysis or both Mathematical Principles of Fluid Mechanics and Mathematical Principles of Continuum Mechanics. A student may not count examinations in both Ordinary Differential Equations and Partial Differential Equations, but both may be included in a student's five subjects. With prior approval of the graduate committee, a student may utilize as a Group IV course a year-long graduate-level sequence from outside the Department of Mathematics. At most one such utilization may be made.

A student may take as many written examinations as desired at any time if the examinations are given, subject to the following conditions:

a. The examinations to be taken must be approved in advance by the student's advisory committee.

b. At any one time a student may take at most only the number of examinations necessary to complete these requirements.

c. A student may take a collection of written examinations a maximum of 3 times, but no one failing 4 examinations, counting possible repetitions, will be permitted to take another examination. An exception is that a student who does not have a master's degree in mathematics and who has been enrolled in a UT graduate program in mathematics no longer than one year may take written examinations at one time during that year without having that sitting for the examinations or any incurred failure(s) count toward the limits imposed above.

d. At least two examinations must be taken and at least one must be passed before the start of a student's fourth year. Three examinations must be passed before the start of a student's fifth year.

In lieu of earning a grade of B+ or better each semester in a sequence from Group I, II, or III, a student may demonstrate proficiency in that subject by passing the associated written examination. For this purpose, only one examination is permitted for each of up to two subjects, and this use of a written examination must be declared before the examination is taken so that the student's examination and any failure are not counted toward the limits in condition c.

Mathematical Ecology Concentration

The student must pass written examinations in three subjects:

2. A subject from Groups I, II, and III of the standard program.
3. A subject represented by a year-long graduate-level sequence from outside the Department of Mathematics. The sequence must be approved in advance by the mathematical ecology faculty and by the departmental Graduate Committee. At least one member of the mathematical ecology faculty must be involved in the grading of the examination. The examination in this subject may be taken only once.

The student also must earn grades of B+ or better each semester in the courses associated with two additional subjects from the groups listed in the standard program. This requirement may not be satisfied with courses from outside the department. At least one of the subjects used to meet this requirement or the written examination subject in 2. must be from Groups I and II.

Except for the privilege of utilizing as a Group IV course a course from outside the department, this concentration is subject to the constraints and privileges specified in the standard program, including the restrictions on related subjects, the conditions a. through d. placed on the taking of written examinations, and the option to pass a written examination in lieu of earning a grade of B+ or better each semester in a sequence from Group I, II or III.
GRADUATE COURSES

400 History of Mathematics (3) Development of major ideas in mathematics and influence of ideas in science, technology, philosophy, art, and other areas. Writing emphasis course: at least one in-class essay examination and 3000 words of writing outside classroom. Prereq: Calculus.

401 Mathematics and Microcomputers (3) Primarily for students seeking certification as mathematics teachers at secondary level. Use of microcomputers to study concepts and problems in mathematics. Does not satisfy the major requirements for a B.S. or M.S. in mathematics. Prereq: Calculus I.

404 Applied Vector Calculus (3) Topics from multivariable and vector calculus; line and surface integrals, divergence, Green, Stokes, and the divergence theorem. Prereq: Calculus III. Recommended prerequisites: Calculus I and II.

405 Models in Biology (3) Difference and differential equation models of biological systems. May not be counted toward graduate degree. Prereq: Calculus II or Biocalculus.


421 Combinatorics (3) Introduction to problems of construction and enumeration for discrete structures: sequences, partitions, graphs, finite fields and geometries, or experimental designs. Prereq: 323 or consent of instructor.


424 Probability II (3) Elements of stochastic processes: Random walk, Markov chains and Poisson processes. Other topics as selected by instructor. Prereq: 423.

425 Statistics (3) Elements of statistical inference: Random variables, cumulative distribution functions, independence, the central limit theorem; point and interval estimation, Bayesian estimation; statistical hypotheses, Neyman-Pearson testing; likelihood; ratio, likelihood ratio test, analysis of variance. Prereq: Consent of instructor. Prereq: Calculus III. Recommended prerequisite: 300-level probability.


443 Complex Variables I (3) Theory of functions of complex variable: residue theory and contour integrals. Prereq: Calculus III. Recommended prerequisite: 300- or 400-level mathematics course.

444 Complex Variables II (3) Applications of complex variables to steady-state temperatures, electrostatics, and fluid flow. Prereq: 443.

445 Advanced Calculus II (3,3) Theory of sequences, series, differentiation, and Riemann integration of functions of one or more variables. Prereq: 341 or consent of instructor.


451 Topics in Algebra (3) Number theory and theory of polynomials: integral domains, factorization, Euclidean algorithm, polynomials, and Sturm separation. Prereq: Algebra I or consent of instructor.

453 Matrix Algebra II (3) Matrix theory including Jordan canonical form. Prereq: Matrix Algebra I.

455-56 Advanced Algebra II (3,3) Algebraic structures: groups, rings, modules, vector spaces, and linear transformations. Prereq: 351 or consent of instructor.

457-58 Honors: Abstract Algebra II (3,3) Honors version of 455-56. Prereq: 351 or consent of instructor.

460 Geometry (3) Axiomatic and historical development of neutral, Euclidean, and hyperbolic geometry stressing geometric proof technique and critical reasoning. Models of Non-Euclidean geometries. Prereq: Calculus II, and Discrete Mathematics I. Recommended prerequisite: Calculus II.

461 Topology (3) Topology of line and plane, separation properties, compactness, connectedness, continuous functions, homoeomorphisms, and totally and topological invariants. Prereq: 341 or consent of instructor.

471 Numerical Analysis I (3) Computation, instabilities, and round-off errors. Approximation by polynomials, and piecewise polynomials. Quadrature and numerical solution of initial and boundary value problems of ordinary differential equations, stiff systems. Prereq: Numerical Algorithms I or consent of instructor. (Same as Computer Science 471.)

472 Numerical Analysis II (3) Direct and iterative methods for systems of linear equations: Solution of single nonlinear equation and nonlinear systems. Orthogonal decomposition, least squares and algebraic eigenvalue problems. Prereq: Numerical Algorithms I or consent of instructor. Recommended prerequisite : 471. (Same as Computer Science 472.)

490 Readings in Mathematics (1-3) Open to students seeking advanced individual study and research in mathematics. Prereq: Consent of instructor. Credit by arrangement. Prereq: Calculus II or Biocalculus. May not apply toward M.S. degree in mathematics. Prereq: 1yr calculus or equivalent.

500 Thesis (1-15) P/NP only. E


505-16 Analytical Applied Mathematics (3,3) Analysis of graviational, electromagnetics and hydrodynamics; partial differential equations; dimensional analysis and scaling, perturbation theory, variational approaches, transform theory, wave phenomena and conservation laws, stability and bifurcations, distributions, integrals, distributions. Prereq: 446 or 448, 453, and either 511-12 or both 431 and 435.

517-18 Mathematical Methods in Physics (3,3) (Same as Physics 571-72.)

519 Seminar in Applied Mathematics (1-3) May be repeated. Maximum 12 hrs.

521-22 Enumerative Combinatorics (3,3) Sieve methods, recurrence, generating functions, and permutation groups. Applied to enumeration of discrete structures: incidence algebra and combinatorics of partially ordered sets.


525-26 Statistics (3,3) Pertinent facts from probability theory: probability of elementary events; normal distribution; Fisher-Neyman factorization theorem, exponential families, Bayesian models; methods of estimation and optimality theory: uniform minimum variance unbiased estimates, asymptotic efficiency and optimality; the confidence procedures and hypothesis testing; optimal tests and confidence intervals, the Neyman-Pearson lemma, uniformly most powerful tests; general linear models, estimation and tests in linear models; non-parametric methods, rank methods for comparison, linear regression and independence, robust tests, topics from decision theory. Prereq: 445-46. Recommended prerequisite: 425.

527 Stochastic Modeling (3) Models in probability applied to real world situations; queuing theory; branching processes; Monte Carlo simulation. Prereq: 445-46 and consent of instructor.


535-36 Partial Differential Equations (3,3) First order equations, classification of equations and properties of solutions, hyperbolic and parabolic equations in several variables. Prereq: 445-46 and 231 or consent of instructor.

537-38 Mathematical Principles of Continuum Mechanics (3,3) Conservation principles, equations of equilibrium for fluids, solids, constitutive relations and stress, convexity properties, bifurcation phenomena, existence theory. Prereq: 431, 435, 446 or 448, or consent of instructor.

539 Seminar in Differential Equations I (1-3) Prereq: Consent of instructor. May be repeated. Maximum 12 hrs.


543-44 Complex Analysis (3,3) Theory of complex functions. Cauchy's theorem, Laurent series, maximum...
579 Seminar in Mathematical Ecology (1-3) May be repeated. Maximum 12 hrs.

593 Independent Study (1-15) See College of Arts and Sciences.

598 Graduate Reading in Mathematics (1-3) Independent study with faculty guidance. Prereq: Graduate standing and consent of instructor. May be repeated. Maximum 6 hrs.

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


619 Seminar in Applied Mathematics (1-3) May be repeated. Maximum 12 hrs.


629 Seminar in Combinatorics (1-3) May be repeated with consent of department. Maximum 12 hrs.

631-32 Advanced Ordinary Differential Equations (3,3) Theory of ordinary differential equations from advanced viewpoint. Topics from current literature. Subject matter varies according to interests and preparation of students. Prereq: 531-32 or consent of instructor. May be repeated with consent of department. Maximum 12 hrs.


643-44 Harmonic Analysis (3,3) Fourier series and transforms on Euclidean spaces or topological groups: convergence, duality, elementary uniqueness, inversion duality, Plancherel transform, Hilbert transform, Hardy-Littlewood maximal function, interpolation of operators, and Fefferman-Stein duality. Prereq: 541-42 and 543. May be repeated with consent of department. Maximum 12 hrs.

649 Seminar in Analysis (1-3) May be repeated with consent of department. Maximum 12 hrs.

651-52 Advanced Modern Algebra (3,3) Selected topics in modern algebra or number theory. Prereq: 581-52 or consent of instructor. May be repeated with consent of department. Maximum 12 hrs.

659 Seminar in Algebra (1-3) Prereq: Consent of instructor. May be repeated with consent of department. Maximum 12 hrs.


667 Geometry of Surfaces (3) Immersed and imbedded surfaces in $\mathbb{R}^3$. First and second fundamental forms; Gauss curvature. Riemannian metric and connection. Introduction to differential forms. Prereq: 563-64. May be repeated with consent of department. Maximum 12 hrs.


669 Seminar in Topology (3) May be repeated with consent of department. Maximum 12 hrs.


679 Seminar in Numerical Mathematics (1-3) May be repeated with consent of department. Maximum 12 hrs.

681-82 Advanced Mathematical Ecology (3,3) Selected topics in theoretical and applied mathematical ecology: population, community, ecosystem ecology and applied topics such as demography, ecotoxicology, epidemiology, environment, and resource management. Prereq: 581-82. May be repeated.

Mechanical and Aerospace Engineering

(Majors)

Aerospace Engineering ........................................... M.S., Ph.D.
Mechanical Engineering ....................................... M.S., Ph.D.

A.J. Edmondson, Acting Head

Professors:

Armilli, R. V., Ph.D............................... VPI
Braun, G. W. (Emeritus) (UTSI), Ph.D....................... Gottingen
Collins, Frank G. (UTSI), Ph.D, Ph.D. ... California
Crawford, R. A. (UTSI), Ph.D.............................. Tennessee
Edmondson, A. J., Ph.D, Ph.D. ................... Texas A&M
Fliandro, Gary A. (Boiling Chair in Space Propulsion) (UTSI), Ph.D............................. Gtech
Garrison, G. W. (UTSI), Ph.D.............................. NC State
Hewgson, J. W. (Fisher Prof.) (PE), Ph.D................... Georgia Tech
Holland, R. W. (Emeritus), Ph.D........................... M.S.
Johnson, W. S., Ph.D, Ph.D. ............................. Pennsylvania
Kranes, R. J., Ph.D........................................ Oklahoma
Liston, Hardy, Jr. (Emeritus), Ph.D......................... George Washington
Lo, C. F. (UTSI), Ph.D................................. Cornell
McRae, R. L. (Emeritus), Ph.D............................. Case Western Reserve
Milligan, Mancil W., Ph.D, Ph.D. ................... Tennessee
Newman, M. K. (Emeritus) (UTSI), Ph.D.................... Georgia Tech
Pitts, Donald R. Ph.D............................... Georgia Tech
Parang, M., Ph.D, Ph.D............................. Oklahoma
Parsons, J. R., Ph.D, Ph.D.............................. NC State
Peters, C. E. (UTSI), Ph.D, Ph.D.......................... Brussels
Pitts, Donald R. Ph.D............................... Georgia Tech
Schult, R. J. (UTSI), Ph.D............................... Georgia Tech
Shaheen, F. (UTSI), Ph.D................................. Oklahoma
Smith, G. V., Ph.D, Ph.D............................... Penn State
Speckhart, Frank H., Ph.D, Ph.D............................ Georgia Tech
Course Option
This option is restricted to those students who have had the equivalent of a thesis experience or, at the time of completion of the degree requirements, have had at least three years of full-time engineering experience since receiving the Bachelor of Science degree. This evaluation of the work experience and the final selection of the student's program of study are left to the student's committee. The requirements of this option are that the student must satisfactorily complete a program of study that includes:

1. A minimum of 30 semester hours of coursework that includes at least 18 semester hours of graduate (500 level or above) courses in the department with at least 12 semester hours in the major and normally 6 semester hours of coursework (400 level or above) in mathematics. No more than 3 semester hours of engineering coursework may be below the 500 level.
2. Participation in the department seminar program.
3. Passing a comprehensive written and oral final examination on all coursework submitted for the degree. The student’s committee will be of sufficient size to include all of the study areas reflected in the course program.

Problems Option
The requirements of this option are that the student must satisfactorily complete a program of study that includes:

1. A minimum of 24 semester hours of coursework that includes at least 12 semester hours (500 level or above) courses in the department with at least 6 semester hours in the major and normally 6 semester hours of coursework (400 level or above) in mathematics. No more than 3 semester hours of engineering coursework may be below the 500 level.
2. A minimum of 6 semester hours in 590 Selected Engineering Problems. A written report must be presented for each problem investigated.
3. Participation in the departmental seminar program.
4. Passing a comprehensive written final examination on all coursework submitted for the degree and an oral examination on all work (including problems).

THE DOCTORAL PROGRAM
Admission into the doctoral program will be granted to those applicants who have demonstrated superior achievement in their engineering background.

The student must satisfactorily complete an approved program of study that includes a minimum of 72 semester hours of courses that count toward the total requirements for the degree. Courses must include:

1. Twenty-four semester hours in doctoral dissertation.
2. A minimum of 12 semester hours of graduate credit in mathematics in courses numbered 400 or above with a minimum of 6 semester hours numbered 500 or above.
3. A minimum of 24 semester hours in the department in courses numbered 500 and above, with at least 12 of these semester hours in the major. A minimum of 9 semester hours of coursework is required at the 600 level. These are exclusive of the thesis, problems, or dissertation credit. The student's advisory committee can approve a student's petition to replace one 600-level course with one or more 500-level courses that are more appropriate.
4. Participation in the departmental seminar program.
5. The passing of a written and oral comprehensive examination is required as well as a successful defense of the dissertation.

ACADEMIC COMMON MARKET
An agreement among southern states for sharing graduate programs allows legal residents of some states to enroll in certain programs at UT Knoxville on an in-state tuition basis. The Ph.D. program in Aerospace Engineering is available to residents of the state of Arkansas or Kentucky. The M.S. in Aerospace Engineering is available to residents of Kentucky. Additional information may be obtained from the Admissions Specialist in the Office of Graduate Admissions and Records.

GRADUATE CREDIT FOR UNDERGRADUATE COURSES
Senior (400-level) mechanical and aerospace engineering courses may be taken for graduate credit by non-mechanical or non-aerospace engineering majors, if approved by the student’s major department. Mechanical or aerospace engineering majors may not normally use more than one 400-level engineering course to meet their advanced degree requirements. Non-mechanical or non-aerospace engineering graduate students should consult with instructors regarding prerequisites for undergraduate courses.

Mechanical Engineering
NOTE: Not all the courses listed below are available at both the UT Knoxville and the UTSI campuses.

GRADUATE COURSES
422 Environmental Noise (3) Basic principles of acoustics: measurements and control of noise in industrial and community environments. Prereq: Senior standing in engineering or consent of instructor.
451 Systems and Controls (3) Analytical models of physical systems comprised of combinations of mechanical, fluid, electrical, and thermal components; feedback control systems, transient and frequency response, stability analysis; non-linear systems, sampled data systems, digital filters. Prereq: Mechanical Engineering Instrumentation and Measurement, Circuits and Electro Mechanical Components. F, Sp
455 Introduction to Design (2) Engineering economy, optimization, design for automation, reliability, and product liability; design of mechanical engineering components. Participation in team design effort; design report. Prereq: Dynamics and Vibrations of Machines.
456 Introduction to Thermal Design (2) Engineering economy, optimization, design for automation, reliability, and product liability; design of mechanical engineering thermal-fluid systems. Participation in team design effort; design report. Prereq: 332, 344, F.
521-22 Thermodynamics I and II (3.3) Macroscopic thermodynamics, including First and Second Law analyses, availability, phase and chemical equilibrium criteria, combustion, gas mixtures, and property relations, determination of fluid properties, ideal and non-ideal fluid structure, spectroscopic data, kinetic theory, statistical mechanics, quantum physics. Schroedinger equation. 

523 Special Topics in Thermodynamics (3) Application of thermodynamic topics to current interests in mechanical engineering. Prereq: Consent of instructor.

525 Combustion and Chemically Reacting Flows I (3) Fundamentals: thermochemistry, chemical kinetics and reaction mechanisms; application of thermodynamic analysis to laminar flames; diffusion and premixed flame theory; single droplet combustion; deflagration and detonation theory; stabilization of combustion waves in laminar streams; fire safety of premixed laminar flames introduction to turbulent flames. Prereq: 522, 531, or consent of instructor.

526 Combustion and Chemically Reacting Flows II (3) Advanced topics: phenomenological approaches to turbulent flames; fundamentals of turbulent flow, application of probability density functions to turbulent flames; turbulent reacting flows with premixed and non-premixed reactants; spray combustion modes; fluidized bed combustion; chemically reacting boundary layer flow; gas turbine and/or rocket combustors; furnaces; introduction to supersonic combustion and hypersonic flows. Prereq: 525.


532 Conservation of Mass, Energy, and Momentum (3) Stress analysis, including finite element method. Prereq: Consent of instructor.

533 Advanced Theory and Application of Fluid Mechanics (3) Advanced theory and application of fluid mechanics. Prereq: Consent of instructor. "3 Seminar (1) All phases of mechanical engineering, reports on current research at UT and UTMSI. May be repeated. Maximum 6 hrs. Prereq: Consent of instructor.


554-55 Advanced Strength of Materials (3,3) Elements of material science and mechanical behavior of materials: stress, strain, deformation, failure, fatigue, and fracture. Prereq: Consent of instructor.

556 Computational Solid Mechanics (3) Application of numerical methods to solve problems in solid mechanics. Prereq: Consent of instructor. May be repeated. Maximum 6 hrs. Prereq: Consent of instructor.

557 Dynamics of Machinery (3) Kinematics and kinetics: fixed, moving and rotating coordinate systems; linear and angular momentum; energy methods; computational techniques derived from Lagrangian and Hamiltonian mechanics; variable mass; rigid body dynamics. Prereq: 383, 391.

559 Vibrations (3) Free and forced vibration of single and multiple degrees of freedom systems, linear and nonlinear. Prereq: Undergraduate vibrations course.


561 Rocket Propulsion I (3) Rocket propulsion fundamentals: thermodynamics of nonreacting and chemically reacting gases, nozzle design, ideal rocket performance parameters; rocket heat transfer; chemistry of propellants; liquid rocket engine systems; ground testing; introduction to solid propellant rockets. Prereq: Consent of instructor.

562 Rocket Propulsion II (3) Solid propellant rocket performance, homogeneous and heterogeneous propellant chemistry and combustion system performance, thermal design and phase transition models, rocket nozzle design, effects of chamber pressure and additives on solid propellant burn rates, erosion burning, analysis of two-phase solid propellant exhaust flow, introduction to nuclear and electric propulsion; electrical resistance and electric field (ion) engine performance, magnetohydrodynamic thrusters, traveling wave thrusters, exotic propulsion systems. Prereq: Consent of instructor.

568-85 Turbomachinery Systems I, II, III (1,3,3) Ideal cycle analysis of turbine engines, real cycle analysis, component performance analysis, component design and systems integration (inlets, nozzles, combustors, compressors, turbines), flow through theory, turbine engine component matching, transient operation, surge and rotating stall, engine control systems, structural considerations. Prereq: First year graduate standing and consent of instructor.


588 Measurement Science I (3) (Same as Nuclear Engineering 588, Atmospheric Science 588, Civil Engineering 588, Mechanical Engineering 588, and Aerospace Engineering 588.)

598 Mechanical Engineering Design Seminar (3) (Same as Mechanical Engineering 598 and Electrical and Computer Engineering 507.)

599 Special Topics in Mechanical Engineering (1-3) Prereq: Consent of instructor. May be repeated. Maximum 6 hrs. Prereq: Consent of instructor.

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

610 Advanced Topics in Fluid Mechanics and Heat Transfer (3) Advanced theory and application of fluid mechanics and heat transfer; natural convection, multiphase flow, high speed and nonreacting flows, advanced boundary layer techniques, combustion, turbulence generation and variational methods of analysis, heat exchanger theory and design. May be repeated. Maximum 9 hrs. Prereq: Consent of instructor.

611 Advanced Convection Heat Transfer, Fluid Mechanics, and Mass Transfer (3) Stagnation point and high speed viscous boundary layer flows; problems in heat transfer at high supersonic and hypersonic speeds; laminar and turbulent boundary layer heat transfer with surface roughness,après-flow, conjugate flows, ideal gas properties; recombination; stagnation point heat transfer, Lee's integral solution for high speed boundary layers; heat flux scaling rules; mass transfer and radiation cooling techniques. Prereq: 512 and consent of instructor.

interaction of thermal radiation with conduction and convection heat transfer. Prereq: 511, 512.


642 Advanced Topics in Thermodynamics (3) Comparison of macroscopic and microscopic approach; equilibrium of pure substances, metastable states. Non-equilibrium thermodynamics. Prereq: Consent of instructor.

561-52 Advanced Topics in Computational Fluid Dynamics (3,3) (Same as Engineering Science and Mechanics 651-52.)

563-54 Advanced Topics in Computational Solid Mechanics (3,3) (Same as Engineering Science and Mechanics 653-654.)


671 Advanced Topics in Applied Artificial Intelligence (3) (Same as Nuclear Engineering 671.)

---

**Aerospace Engineering**

NOTE: Not all the courses listed below are available at both the UT Knoxville and the UTSI campuses.

### GRADUATE COURSES


423 Viscous Flow (3) Boundary layer theory; laminar and turbulent flow; compressibility effects; numerical solution methods. Prereq: 422 or Heat Transfer or consent of instructor. Sp.


425 Propulsion (3) Principles of propulsion devices: turbojet, ramjet and rocket engines. Prereq: 351. F.

426 Introduction to Aerospace Design (2) Design process, synthesis, safety, reliability, patents, product liability, economic analysis, optimization, design standards, design studies. Individual design reports. Prereq: 351, 370, 363. Coreq: Mechanical Engineering 444. F.

429 Aerospace System Design (4) Synthesis and design of complete aerospace system, economic and technical aspects. Participation in team design effort, formal presentations and design report. Prereq: 426, 426, Sp.

449 Aerospace Engineering Laboratory (3) Designing, conducting, and reporting results of experimental exercises. Test standards and specifications. Analysis of data and formation of conclusions. Prereq: 345, 351, 3 labs. F.

495 Selected Topics in Aerospace Science (1-4) Current problems and topics in aerospace science. Prereq: Consent of instructor.

500 Thesis (1-15) PNP only. E.

502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only. E.

511 Inviscid Flow (3) Kinematics and dynamics of inviscid fluid flow about bodies of conformal mapping. Prereq: 422 or Mechanical Engineering 531, Mathematics 425 or equivalent.

512 Viscous Flow (3) Equations of viscous fluid flow; laminar and turbulent flow; transition; separation; boundary layer theory; exact and approximate solutions. Prereq: Mechanical Engineering 531 or equivalent.

513 Experimental Methods in Fluid Mechanics (3) Experimental techniques with laboratory experiences: representative experiments: hot wire anemometry and turbulence measurements, flow visualization, wind tunnel experiments, supersonic flow experiments, boundary layer measurements. Prereq: 423 or Mechanical Engineering 531.

515-16 Air Vehicle Aerodynamics and Performance (3,3) Application of aerodynamic 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. Prereq: 422, 515 for 516.

522-24 Aerodynamics of Compressible Fluids (3,3) One-dimensional internal and external flow; waves; small perturbation theory; slender body theory; stability rules; method of characteristics. Prereq: 422 for 521; 521 for 522.

525 Hypersonic Flow (3) Boundary layer flow; similarity; Newtonian theory; blunt body flow; viscous interactions: free molecule and rarefied gas flow. Prereq: 512.

527-28 Aerospace Ground Test Facilities (3,3) 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. Prereq: 521 and 522, Mechanical Engineering 513 and 522.

529 Rarefied Gas Dynamics (3) Binary elastic collisions; kinetic theory; flow regimes; Boltzmann and model equations; transition regions, gas-surface interactions; slip boundary conditions, free molecule, slip and transition flow; Monte Carlo simulation; experimental techniques. Introduction to hyperbolic gas flows. Prereq: 522, Mechanical Engineering 529.

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

532 Introduction to Turbulence (3) Microscopic effects, analogies, statistical treatment, correlation functions, energy spectra, diffusion, application of turbulent jets and pipe flow. Prereq: 511-12.

534 Atmospheric Entry (3) Reentry trajectories; lift and drag during reentry; vehicle motion and stability during reentry, aerodynamic heating and heat protection systems. Prereq: 522. Recommended prereq: 512.

544 Transonic Flow (3) Nature of flow at transonic speeds; small disturbance theory; shock wave properties; shock-free flows; strong viscous interaction phenomena; subsonic techniques. Prereq: 422, 424.


545-55 Aircraft Vehicle Stability and Control (3,3) Static and dynamic longitudinal directional and lateral stability and control. Coupled motions. Motion with free and fixed control flight surfaces. Automatic control systems. Prereq: 423, 551.


557 Aircraft Vehicle Flutter and Vibration (3) Aeroelastic phenomena, structural and aerodynamic operators, stability criteria for airfoils operating in oscillating stream. Two- and three dimensional flutter of wings, control surfaces and empennage. Prereq: 422, 424, 551.


561 Fundamentals of Aeronautics (3) Generation, propagation and absorption of sound in static and moving media. Prereq: Consent of instructor.

564 Spacecraft Attitude Dynamics and Control (3) Rotation of spacecraft, and attitude dynamics of space vehicles. Gyroscopic instruments; passive and active attitude control devices. Linear control theory and attitude stabilization. Prereq: 551, Mathematics 471.

574 Space Engineering: Satellite Technology (3) Satellite orbits and transfers; objects in orbit; orbital mechanics, rocket engines, spacecraft structure, power systems, attitude control system, telemetry, tracking and command, and communications, spacecraft testing, reliability, and application of satellites (communications, reconnaissance, Earth observation, and future applications). Prereq: 425, Mathematics 471, 404.

588 Measurement Science (1) (Same as Nuclear Engineering 588, Civil Engineering 588, Engineering Science and Mechanics 588, and Mechanical Engineering 588.)

590 Selected Engineering Problems (2-6) Enrollment limited to students in programs program. Prereq: Consent of advisor.

595 Seminar (1) All phases of aerospace engineering, reports on current research at UT. May be repeated. S/NC only.

598 Special Topics in Aerospace Engineering (1-3) May be repeated. Maximum 6 hrs.

600 Doctoral Research and Dissertation (3-15) PNP only. E.

631 Magnetohydrodynamics (3) Electromagnetic field equations, motions of single charged particle, statistical description of plasma, Boltzmann equation, magnetic field lines, and diffusion in ionized gases, continuum magnetohydrodynamical equations. Prereq: coreq: 512. Prereq: Mathematics 545 or equivalent.

632 Magnetohydrodynamics II (3) Air and shock waves, exact solution for magnetohydrodynamical channel flow, one-dimensional model of channel flow, engineering applications of magnetohydrodynamical, propulsion and power generation. Prereq: 631 and Mathematics 562.

641-42 Physical Gas Dynamics (3,3) 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 transitional (non-equilibrium). Prereq: 522, Mechanical Engineering 529.

645 Theory of Turbulence (3) (Same as Engineering Science and Mechanics 445.)

651-52 Advanced Aerodynamics (3,3) Subsonic, transonic, supersonic, and hypersonic flows treated in generalized and unified manner with combined viscous/inviscid effects. Relationships among various regimes of fluid flows. Fundamental assumptions, limitations of approximations and consequences. Foundations of gas dynamics, applications to airplanes, rockets, ground testing and jet propulsion. Discussion of special topics according to interest of students. Prereq: 511, 522.


690 Advanced Topics in Aerospace Engineering (3) Prereq: Consent of instructor. May be repeated. Maximum 9 hrs.

---

**Medical Biology**

See College of Veterinary Medicine and Comparative and Experimental Medicine

**Metallurgical Engineering**

See Materials Science and Engineering
Microbiology

(College of Arts and Sciences and College of Veterinary Medicine)

MAJOR DEGREES
Microbiology .................................... M.S., Ph.D.
Veterinary Medicine .......................... D.V.M.

Dwayne Savage, Head

Professors:
Beck, Raymond W. (Emeritus), Ph.D. Wisconsin
Becker, Jeffrey M., Ph.D. ....................... Cincinnati
Montie, T. C., Ph.D. ............................... Maryland
Moore, R. N., Ph.D. ............................. Texas
Riggsby, W. Stuart (Liaison), Ph.D. ........ Yale
Moore, R. N., Ph.D. ............................. Texas
Montie, T. C., Ph.D. ............................. Maryland
Becker, Jeffrey M., Ph.D. .................... Cincinnati
Beck, Raymond W. (Emeritus), Ph.D. Wisconsin

Ward, J. M. (Emeritus), Ph.D. .............. Kansas
Wust, Carl J. (Emeritus), Ph.D. ............. Indiana

Assistant Professor:
Hacker, David, Ph.D. ........................... Michigan State
Lampson, Bert C., Ph.D. ........................ Missouri
Villafane, Robert J., Ph.D. ..................... NYU
Zaghouani, Habib, Ph.D. ..................... Paris

Microbiology

The Department of Microbiology offers both the M.S. and Ph.D. Students have the option of selecting from a variety of graduate research programs. For a departmental brochure, contact the department head.

ADMISSION REQUIREMENTS

Students are expected to have completed an undergraduate program with a 3.0 or better GPA on a 4.0 system. Included in the undergraduate course credits should be (1) a full year of general biological science, (2) one year of calculus, (3) two years of chemistry, including one year of organic, (4) one year of physics, and (5) an introductory course in microbiology. In many cases, deficiencies in requirements may be removed by taking appropriate courses during the first year of graduate study. The department also requires the general portion of the Graduate Record Examination. A satisfactory score on each part is 550 or higher with rare exceptions. Three letters of recommendation should be submitted by current or former faculty members.

Each new graduate student meets with an advisory committee chaired by the departmental Director of Graduate Studies to plan a program of study for the first year or two semesters until a research advisor is selected. All first-year students participate in a laboratory rotation program during the first semester of study. This program allows the student to adjust smoothly to the research programs of the department, to develop a background of research procedures and concepts, and to facilitate the selection of a research professor. Usually the student selects a research professor toward the end of the laboratory rotation period. The major professor assists in the selection of and carrying out of a suitable research program and in the naming of a thesis or dissertation committee.

THE MASTER'S PROGRAM

The program leading to the M.S. is designed to provide the student with broad basic knowledge, to permit the acquisition of technical competence in the fundamentals of research, and to encourage creative and independent thinking. Two to three calendar years are usually needed for the course of study that has the following requirements: (1) 30 hours including 6 thesis credits; (2) a 3.0 GPA in all courses taken for graduate credit after 12 hours of credit have been earned in courses graded on the A-F system; (3) a 3.0 GPA in courses taken in the department; (4) a complete course sequence in biochemistry or molecular biology; (5) presentation of a research thesis and its oral defense.

THE DOCTORAL PROGRAM

The program leading to the Ph.D. is designed to develop the student's ability to pursue independent and original research in microbiology and allied fields, to teach both oral and written communication of the results of research to the scientific community, and to train effective teachers. Students may enter the program after receiving either a bachelor's or master's degree. Students who enter with a bachelor's degree usually receive the Ph.D. after four or five years; those with the master's degree usually take three or four years to complete the degree. Doctoral requirements are: (1) a 3.0 GPA in all courses taken for graduate credit after 12 hours of credit have been earned in courses graded on the A-F scale; (2) a 3.0 GPA in courses taken in the department; (3) satisfactory performance in at least one semester as a teaching assistant; (4) one semester of physical chemistry; (5) one course in statistics; (6) two semesters of biochemistry or molecular biology; (7) satisfactory performance in a comprehensive examination that must be attempted before the end of the fifth semester in the program and passed before admission to candidacy; and (8) the presentation of a research dissertation and its oral defense.

GRADUATE COURSES

410 Bacterial Physiology (3) Modern concepts of structure and function of bacterial cell. Prereq: Introduction to Microbiology. F
411 Bacterial Genetics (3) Transmission and expression of genetic information by bacteria. Prereq: Introduction to Microbiology. Sp
420 Medical Microbiology (3) Disease-producing microorganisms, including bacteria, rickettsias, chlamydia and fungi. Prereq: Introduction to Microbiology. Sp
429 Medical Microbiology Laboratory (2) Laboratory exercises designed to accompany 420. Prereq: Introduction to Microbiology. Coreq, 420. Sp
430 Immunology (12) Principles of inflammation and immunity; immunoglobulin structure and theories of formation and diversity; complement, hypersensitivities, cell cooperation and recognition in immune mechanisms; soluble factors. Prereq: Biology 250. (Same as Zoology 430.) F
439 Immunology Laboratory (2) Laboratory exercises designed to accompany 430. Coreq, 430. (Same as Zoology 439.) F
449 Virology Laboratory (1) Laboratory procedures for isolation, handling, and culturing of animal viruses. Prereq: 310. Coreq: 440. Sp
470 Microbial Ecology (3) Physiological diversity and taxonomy of microorganisms from natural environments. Functional role of microorganisms in natural and simulated ecosystems. Prereq: 310. F
500 Thesis (1-15) P/NP only, E
502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only. E
570 Applied and Environmental Microbiology (3) Topics in applied and environmental microbiology that treat physiology, metabolism, and genetics of microorganisms; fermentation of natural and simulated ecosystems. Prereq: 470 or consent of instructor.
575 Applied Microbiology and Bioengineering (3) (Same as Chemical Engineering 575, Environmental Engineering 575, and Agricultural Engineering 575.)
591 Foreign Study (1-15) See College of Arts and Sciences.
592 Off-Campus Study (1-15) See College of Arts and Sciences.
593 Independent Study (1-15) See College of Arts and Sciences.
594 Selected Topics in Microbiological Research (2-4) Literature surveys and discussions of selected topics. Prereq: Graduate standing. May be repeated. Maximum 6 hrs. S/NC only.
595 General Seminar (1) Lectures and seminars by invited speakers, faculty, and graduate students. May be repeated. Maximum 18 hrs. S/NC only. E
596 Laboratory Rotation (1) Familiarization with research areas in department through series of rotations in laboratories of individual faculty members. May be repeated. Maximum 3 hrs. S/NC only.
600 Doctoral Research and Dissertation (3-15) P/NP only.
601 Journal Club in Microbial Physiology (1) Readings and discussions based on current literature. May be repeated. Maximum 18 hrs. S/NC only. E
602 Journal Club in Microbial Pathogenesis (1) Readings and discussions based on current literature. May be repeated. Maximum 18 hrs. S/NC only. E
603 Journal Club in Immunology (1) Readings and discussions based on current literature. May be repeated. Maximum 18 hrs. S/NC only. E
604 Journal Club in Virology (1) Readings and discussions based on current literature. May be repeated. Maximum 18 hrs. S/NC only. E
605 Journal Club in Microbial Genetics (1) Readings and discussions based on current literature. May be repeated. Maximum 18 hrs. S/NC only. E
610 Topics in Microbial Physiology (1-3) Prereq: 410 or consent of instructor. May be repeated. Maximum 12 hrs.
620 Topics in Microbial Pathogenesis (1-3) Prereq: 420, 430 or consent of Instructor. May be repeated. Maximum 12 hrs.
630 Topics in Immunology (1-3) Prereq: 430 or consent of instructor. May be repeated. Maximum 12 hrs.
640 Topics in Virology (1-3) Prereq: 440 or consent of instructor. May be repeated. Maximum 12 hrs.
650 Advanced Topics in Microbial and Molecular Genetics (3) Prereq: 411 or consent of instructor. May be repeated. Maximum 12 hrs.
670 Advanced Topics in Environmental Microbiology (1-3) Prereq: 570 or consent of instructor. May be repeated. Maximum 12 hrs.
The Department of Music offers the Master of Music degree with concentrations in accompanying, instrumental conducting, composition, music education, musicology, performance (organ, piano, strings, voice, winds, and percussion), piano pedagogy and literature, sacred music, string pedagogy, and theory.

Applicants must complete an undergraduate degree approximately equivalent in music requirements to those required in degrees conferred by UT Knoxville, appropriate to the applicant's prospective area of concentration on the master's level.

Applicants who plan to pursue the concentration in performance or music education are required to audition before the appropriate area faculty committee. Applicants for admission to the program in composition must submit scores and tape recordings of representative works. Applicants for the concentration in jazz must audition in jazz improvisation and jazz piano proficiency and interview with members of the faculty in this area. Other applicants are required to have an interview with members of the faculty of the prospective area of concentration.

All applicants are required to take the Diagnostic Examinations in music theory, ear-training, and music history/literature. These examinations are given by the Department of Music at the beginning of each semester.

THE MASTER'S PROGRAM

A minimum of 30-33 semester hours of coursework is required for the Master of Music degree. These hours are specifically distributed according to the area of concentration. All concentrations require coursework in music history/literature and music theory and allow for elective courses. Specific curricula are available from the department.

The graduate recital is given in lieu of thesis by students with concentrations in performance, pedagogy, conducting, and musicology. A performance project is given in lieu of thesis by students with concentrations in performance, pedalology, and conducting, and sacred music. A thesis is required of students in composition, musicology, and theory. All concentrations require a written and oral final examination.

Concentration in Music Education

The concentration in music education is designed for persons who hold a Bachelor's degree in Music or Music Education and certification to teach music in schools. Students seeking initial certification should consult the requirements for the Master of Science degree in the College of Education.

The program requires 510 and 520, 9 hours of music education electives at the 500 level; 6 hours of Thesis 500; 6 hours of 500-level courses in music theory or history; 2 hours of applied music at either the 400 or 500 level; 2 hours of music ensemble at the 500 level; and 3 hours of electives at the 500 level.

A three credit research problem and three extra hours coursework in Music Education may be substituted for Thesis. If a larger thesis problem is desired, the thesis credit may be increased to 9 hours, and 3 hours of Music Education electives may be dropped.

Diagnostic tests in theory, ear training, and music history will be required.

Music Education

GRADUATE COURSES

500 Thesis (1-15) P/NP only. E
502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses departmental facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/N only. E
510 Foundations of Music Education (3) Historical, philosophical and aesthetic bases. Prereq: Consent of instructor.
520 Research in Music Education (3) Definition of research problems, data collection and analysis, and research report writing. Application of knowledge of research techniques to analysis of existing research literature in music education. Prereq: Consent of instructor.
530 Advanced Band Literature and Conducting (3) Reading, interpreting and conducting band scores suitable for school, college, and community bands; contemporary and standard band literature. Prereq: Consent of instructor.
550 Curriculum Development and Evaluation in Music Education (3) Principles of curriculum development applied to music education programs. Formulating objectives; construction of evaluation instruments; survey of appropriate literature. Prereq: Consent of instructor.
560 Psychology of Music Teaching (3) Research on musical perception and cognition and its application to teaching of music. Definition and measurement of musical ability. Prereq: Course in general psychology and 1 yr of music theory or consent of instructor.
580 Seminar in Music Education (3-1) Prereq: Consent of instructor. May be repeated. Maximum 6 hrs.
590 Special Topics in Music Education (1-3) Prereq: Consent of instructor. May be repeated. Maximum 6 hrs.
598 Special Problems in Music Education (3) Prereq: Consent of instructor. May be repeated. Maximum 6 hrs.

Music Ensemble

GRADUATE COURSES

503 Small Jazz Ensemble (1) May be repeated. Maximum 12 hrs.
504 Jazz Ensemble (1) May be repeated. Maximum 12 hrs.
505 Studio Orchestra (1) May be repeated. Maximum 12 hrs.
506 Trombone Choir (1) May be repeated. May not be used toward degree requirements. May be repeated. S/N only. E
510 Percussion Ensemble (1) May be repeated. Maximum 6 hrs.
511 Marimba Choir (1) May be repeated. Maximum 6 hrs.
515 Chamber Music Ensemble (1) May be repeated. Maximum 12 hrs.
520 UT Singers (1) May be repeated.
530 Chamber Singers (1) May be repeated.
540 Opera Theatre (1) May be repeated.
550 Concert Band (1) May be repeated.
552 Campus Band (1) May be repeated.
564 Varsity Band (1) May be repeated.
556 Laboratory Band (1) May be repeated.
570 Symphony Orchestra (1) May be repeated.
580 Concert Choir (1) May be repeated.
583 Men's Chorale (1) May be repeated.
588 Women's Chorale (1) May be repeated.
599 Accompanying (1) May be repeated.
Music General

GRADUATE COURSES

500 Thesis (1-15) P/NP only. E
501 Graduate Recital (2)
502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only. E
511 Lecture Recital (2)
521 Special Topics in Performance (1-3) Prereq: Consent of department head.
540 Secondary Applied Music (1) May be taken by music majors desiring applied study on a 2nd or 3rd instrument. May be repeated for a maximum of 4 hours credit on each instrument. Admission by audition. Requires payment of Applied Music fee
561 Church Music Performance Project (1-2) May be repeated. Maximum 6 hrs.

Music History

GRADUATE COURSES

410 Music History Genre (3) Topics vary. May be repeated. Maximum 6 hrs.
420 History of Opera (3) Dramatic, vocal, and orchestral elements in opera of Italian, French, and German schools, 1600-present.
430 Symphonic Literature (3) Literature for orchestra from Baroque to present, evolution of symphony.
440 Music of North America (3) Folk and art music of U.S. and Canada from colonial times to present.
450 Composer Seminar (3) Life and works of single composer. Subject vary.
460 Music Aesthetics (3) Nature of music and musical experience, sense perception and emotions, music, and role of artist in society. Aesthetic viewpoint of individuals and historical era through selected writings.
480 Music in Christian Worship (3) Hymnody, liturgy, and liturgical music.
490 Church Music Methods and Administration (3)
510 Music Bibliography (2) Bibliographic methodology in music.
520 Music Research (1) Principles of research methodology applied to writing of research proposal and project.
530 Music in the Middle Ages (3) Gregorian and medieval chant; secular monophony, and rise of polyphony.
540 Music in the Renaissance (3) From 1400 to 1600. Mass, motet, chansons, madrigal, and other vocal and instrumental forms and genres.
550 Music in the Baroque Period (3) From c. 1600 to 1750; rise of opera and oratorio; sacred and secular cantatas, instrumental forms, performance practice.
560 Music in the Classic Period (3) Evolution of classical style from pre-classic music to music of Haydn, Mozart, and early Beethoven.
570 Music in the Romantic Period (3) Nineteenth-century musical styles from Beethoven to post-romantics.
580 Music in the Twentieth Century (3) From 1900, Debussy, to present, Stockhausen and others.
590 World Music (3) Attitudes and techniques of ethnomusicology. Survey of world music cultures. Interview and transcription projects.
593 Independent Study (1-15) See College of Arts and Sciences. Prereq: Consent of department head.

Music Instrumental

GRADUATE COURSES

490 Instrumental Conducting (3) Development of knowledge and skills in instrumental conducting; study of various periods and composers and relationship of different styles to conductor's art; musical analysis and practice in conducting. Prereq: Music Education 220 or equivalent.
570 Advanced Suzuki Pedagogy (1) Study of psychology, procedures, and literature utilized by Shinobu Suzuki in Japan. Prereq: 495 or consent of instructor. May be repeated. Maximum 4 hrs.
580 Band Literature (3) Band literature and origins of band, its important expanded cultivation during past century in United States and Europe. Prereq: Consent of instructor.
582 Advanced Applied Suzuki (1) May be repeated. Maximum 6 hrs.
585 Instructional Conducting Seminar (3) Rehearsal and performance problems and techniques allied to score reading and preparation. Particular attention to individual problems. Prereq: 490 or equivalent.

Music Jazz

GRADUATE COURSES

410 Advanced Improvisation (3) Further development of individual skills and solving individual problems in jazz improvisation. Prereq: 210 and 220.
420 Jazz Pedagogy (1) Methods and materials relating to teaching of jazz, designing and administering jazz programs, and rehearsal techniques for jazz ensembles. Prereq: Studio music and jazz major or consent of instructor.
520 Piano Literature Seminar (3) Topics vary.

Music Keyboard

GRADUATE COURSES

420-30 Piano Literature 1,11 (3,3) 420--From 1750 to middle 18th century; 430--Middle 19th century to present; problems of style and interpretation; pedagogical literature and methods; organ design. Prereq or coreq: Music History 220 and consent of instructor.
485-95 Suzuki Piano Method 1,11 (2,2) Psychology, procedures, and literature of Suzuki piano method. Must be taken in sequence. Prereq: Consent of instructor.
520 Piano Literature Seminar (3) Topics vary. May be repeated. Maximum 6 hrs.
531-41 Recital Project (2.2) Preparation and accompanying of full recital for accompanying concentrations only. 531--Vocal recital, 541--Instrumental recital. Prereq: Consent of instructor.
540-50 Advanced Piano Pedagogy II, I (2,2) Evaluation and study of methods and materials for teaching piano at all levels. Supervised laboratory teaching. Prereq: 440, 450, or consent of instructor. 550--Introduction and principles of Kodaly, Orff, Suzuki, Dalcroze Eurhythmics, and class piano teaching. Prereq: 440, 450 or consent of instructor.
560 Organ Literature Seminar (3) Topics vary. May be repeated. Maximum 6 hrs.

Music Performance

GRADUATE COURSES

403 Flute (1-4)
405 Oboe (1-4)
410 Bassoon (1-4)
415 Clarinet (1-4)
420 Saxophone (1-4)
425 Horn (1-4)
430 Trumpet (1-4)
435 Trombone (1-4)
440 Baritone (1-4)
445 Tuba (1-4)
450 Percussion (1-4)
455 Voice (1-4)
460 Violin (1-4)
465 Viola (1-4)
470 Cello (1-4)
475 String Bass (1-4)
476 Electric Bass (1-4)
479 Guitar (1-4)
480 Piano (1-4)
485 Harpsichord (1-4)
490 Organ (1-4)
494 Composition (1-3)
495 Composition with Electronic Media (1-3)
496 Composition for Media (2)
499 Improvisation (1-2) May not be used toward applied music requirement.
503 Flute (1-4)
505 Oboe (1-4)
510 Bassoon (1-4)
515 Clarinet (1-4)
520 Saxophone (1-4)
525 Horn (1-4)
530 Trumpet (1-4)
535 Trombone (1-4)
540 Baritone (1-4)
545 Tuba (1-4)
550 Percussion (1-4)
551 Accompanying and Coaching (1-4)
555 Voice (1-4)
560 Violin (1-4)
565 Viola (1-4)
570 Cello (1-4)
575 String Bass (1-4)
576 Electric Bass (1-4)
579 Guitar (1-4)
580 Piano (1-4)
585 Harpsichord (1-4)
590 Organ (1-4)
594 Composition (1-3)
595 Composition with Electronic Media (1-3)
599 Improvisation (1-4)
Nuclear Engineering

Graduate Courses

MAJOR

DEGREES

Nuclear Engineering ........................................ M.S., Ph.D.

Professors:

Dodd, H. L., PE, Ph.D. ..................... Tennessee
Kelten, T. W. (Lieison), Ph.D. .............. Tennessee
Mihalceo, J. T., Ph.D. ...................... Texas A&M
Miller, L. P., PE, Ph.D. ................... Texas A&M
Ferris, R. B., Ph.D. ....................... Madrid
Stevens, P. N., PE, Ph.D. ................. Northwestern
Uphoff, R. E. (Distinguished Prof.), PE, Ph.D. ............ California

Associate Professors:

Groer, P. G., Ph.D. ....................... Vienna
Katz, E. M., PE, Ph.D. .................... Tennessee
Scott, T. H., PE, Ph.D. .................... Florida

Assistant Professor:

Ruggles, A. E., Ph.D. ..................... Rensselaer

The Department of Nuclear Engineering offers programs leading to the Master of Science and Doctor of Philosophy degrees. Students are selected on the basis of academic record and suitability for graduate work in the field of nuclear engineering. The Masters degree may be obtained by following the program of study described below.

The comprehensive examination is prepared by the nuclear engineering faculty and consists of a written examination which the student must pass in order to continue in the program. The student must complete 24 semester hours of coursework approved by the student's advisory committee that includes the following:

1. A minimum of 24 semester hours in nuclear engineering courses numbered 500 or above (or the equivalent), with at least 6 semester hours of 600-level courses. These are exclusive of thesis or dissertation credit.

2. A minimum of 12 semester hours in mathematics, computer science, or statistics courses beyond nuclear engineering undergraduate requirements number 400 or above.

3. A minimum of 8 semester 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.

4. A reading knowledge of one foreign language may be specified by the student's departmental committee.

5. The comprehensive examination is prepared by the nuclear engineering faculty and consists of 12 hours of written examinations. All past examinations are filed in the library, and students are encouraged to review them. Students are invited to take the comprehensive examination after completing approximately 30 semester hours of coursework. A student who fails the written examination must take and pass the examination the next time it is offered to remain in the Ph.D. program.

Registration for NE 600 is not permitted until the written examination is passed. The comprehensive examination is completed with a successful oral defense of the dissertation proposal.
A candidate must successfully defend, in an oral examination, all work presented for the degree—all coursework and the dissertation.

ACADEMIC COMMON MARKET

An agreement among southern states for sharing graduate programs allows legal residents of some states to enroll in certain programs at UT Knoxville on an in-state tuition basis. The Ph.D. program in Nuclear Engineering is available to residents of the states of Alabama, Kentucky, or Mississippi. The M.S. program is available to residents of the states of South Carolina or Virginia (concentrations in radiological engineering only). Additional information may be obtained from the Admissions Specialist in the Office of Graduate Admissions and Records.

GRADUATE CREDIT FOR UNDERGRADUATE COURSES

400-level courses in nuclear engineering may be used for graduate credit. However, students must take at least two-thirds of the minimum required hours (30) in a master's degree program must be taken in courses numbered 500 or above.

UNDERGRADUATE COURSES

403 Nuclear Engineering Laboratory (3) Cross-section measurement; diffusion properties of neutrons, critical loading experiment, control rod calibration, statistical weight, shielding, xenon poisoning, dynamics and controls experiments. Prereq: Nuclear Engineering Laboratory or equivalent. Coreq. 471, 405.


405 Reactor Dynamics, Control and Safety (3) Reactor models, transient analysis, safety analysis, control systems and safety systems. Prereq. 470.


421 Introduction to Nuclear Criticality Safety (3) Fundamentals of nuclear criticality safety; criticality accidents; safety standards, overview of experiments, computational methods, and Monte Carlo. Prereq. Introduction to Nuclear Engineering.


432 Radiation Risk Analysis (3) Radiation risk estimates for external and internal radiation, dose-response models, dose rate effects, prediction of radiation risks, radiation safety standards.


463 Introduction to Fusion Energy I (3) (Same as Electrical and Computer Engineering 463.)

464 Introduction to Fusion Energy II (3) (Same as Electrical and Computer Engineering 464.)


471 Nuclear Reactor Theory II (3) Thermal spectrum computational methods: heterogeneous effects in fast and thermal spectra; considerations in reactor core design; equations that describe thermal and nuclear reactor states; power distribution calculations and reactivity control methods. Prereq. 470.

483 Special Topics in Nuclear Engineering (3) Problems related to recent developments and practice. Prereq. Senior standing and consent of instructor. May be repeated. Maximum 6 hrs.

500 Thesis (1-15) P/NP only. E

502 Registration for Use of Facilities (1-15) Required to use university facilities. May be repeated. S/NC only.

511-12 Transport Processes in Nuclear Engineering (3,3) Rheology of newtonian and non-newtonian fluids; integral and system conservation equations for single and multi-component fluids; development of differential conservation equations for mass, energy, and momentum; exact and approximate solutions of equations of motion; boundary layer analysis; numerical analysis of fluid flow and heat transfer.

521 Nuclear Systems Dynamics and Control (3) Introduction to state variable methods for system dynamics and control analysis and application of these methods to nuclear plant dynamics, simulation and control problems.

522 Experimental Methods in Reactor Dynamics (3) Introduction to time domain and frequency domain techniques. Measurement, analysis, and interpretation of processes signals for reactor analysis; numerical analysis; numerical analysis of fluid flow and heat transfer.

541 Reactor Fuel Management (3) Topics relative to core fuel management. Applicable topics in reactor physics, fuel cycle, fuel handling, fuel loading, and management of radiochemicals. Prereq. 401.


543 Selected Topics in Nuclear Criticality Safety (3) Criticality safety computational and experimental methods for enrichment, fabrication, storage, reprocessing, and transport applications; overview of safety practices and regulatory requirements. Prereq. 421 or consent of instructor.

550 Nuclear Instrumentation (3) Physics and electronics associated with radiation detection, methods of data analysis, applicability of particular instrumentation and measurement methods to nuclear instrumentation operation.

551 Radiation Protection (3) Interactions of photons, neutrons, beta particles, and heavy charged particles with matter and their mechanisms of energy loss; methods of radiation detection, internal and external radiation dosimetry; chemical and biological effects of radiation; regulations and standards. Prereq. Introduction to Nuclear Engineering and Differential Equations I or equivalents.

552 Radiation Monitoring and Dose Assessment (3) Methods for area work and environmental monitoring; dose assessment; pathways analysis; risk projections and regulations. Prereq. 551.

561 Plasma Diagnostics I (3) (Same as Electrical and Computer Engineering 561.)


572 Nuclear System Design (3) Design and analysis of a nuclear system, interface with non-nuclear aspects of system design: system reliability and economics, class project. Prereq. 571 or consent of instructor.

575 Applied Artificial Intelligence (3) Symbolic methods for artificial intelligence applications to engineering problems. Prereq. Consent of instructor. (Same as Engineering Science and Mechanics 575 and Mechanical Engineering 575.)

576 Expert Systems in Engineering (3) Application of expert systems in engineering: logic and rationale, developing expert systems, programming, advanced topics. Prereq. 575 or consent of instructor. (Same as Engineering Science and Mechanics 576 and Mechanical Engineering 576.)

577 Neural Networks in Engineering (3) Neural network technology for use in intelligent systems: rationale for neural computing, structure of neural computing systems, programming. Prereq. Consent of instructor. (Same as Engineering Science and Mechanics 577 and Mechanical Engineering 577.)

578 Fuzzy Systems in Engineering (3) Fuzzy numbers, fuzzy environment, uncertainty and randomness, approximate reasoning, fuzzy models and structures, decision process in fuzzy environment, fuzzy computing, fuzzy logic controllers, fuzzy expert systems and other engineering applications. (Same as Engineering Science and Mechanics 578.)


585 Process System Reliability and Safety (3) Qualitative and quantitative techniques for assessing and improving process systems for reliability and safety. Fault tree analysis and associated dependent failure analysis. (Same as Chemical Engineering 585.)


589 Measurement Science II (3) Modern industrial measurement systems, advanced topics in measurement, Prereq. 586. (Same as Aviation Systems 589 and Engineering Science and Mechanics 589.)

597 Special Topics in Nuclear Engineering (3) Lectures and recitation on recent advances in nuclear engineering. Prereq. Consent of instructor. May be repeated with consent of department.

598 Nuclear Engineering Practice (3-9) Experience in solving and reporting on engineering problems. Prereq. Approval of department. May be repeated limited to alternative plan students. S/NC only.

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

611-12 Selected Topics in Reactor Theory (3,3) Transport theory, control rod theory, stochastic methods. Selected topics from literature. Prereq. 577.

621 Selected Topics in Radiation Protection (3) Prereq. 551, 552. May be repeated with consent of department.

635 Theory of Information Processing (3) Modern system theoretical methods for evaluating system performance from dynamic measurements. Prereq. 592 or equivalent.

671 Advanced Topics in Applied Artificial Intelligence (3) Recent advances in applications of artificial intelligence. Prereq. 577. (Same as Engineering Science and Mechanics 571 and Mechanical Engineering 571.)

679 Special Topics in Nuclear Engineering (3) Investigation of new developments. Prereq. Consent of instructor.

680 Nuclear Engineering
Nursing

(College of Nursing)

MAJOR

DEGREE

Nursing

M.S.N., Ph.D.

Joan E. Uhl, Dean

Mildred M. Fenske, Associate Dean for Academic Programs

Sandra Thomas, Director of Ph.D. Program

Inez Tuck, Director of MSN Program

Professors:

Allgood, Martha R., Ph.D. ......... New York

Dyke, Teresa E., Ph.D. .......... Kentucky

Campbell, John M., Ph.D. ...... Tennessee

Duff, Kelly, Ph.D. .......... Tennessee

Forsythe, Mary, Ph.D............ Tennessee

Kollar, Mary, Ph.D. .......... Tennessee

Modricin-McCarthy, Mary Anne, Ph.D. .. Pennsylvania

Smith, Helen, Ph.D. ............ Tennessee

Tuck, Inez, Ph.D. ......... North Carolina (Greensboro)

Assistant Professors:

Branson, Janice O., M.S.N. ......... Tennessee

Brown, Aline J., M.S.N. ........ Tennessee

Conlon, Kathleen P., M.S.N. ......... Tennessee

Evans, Ginger W., M.S.N. .......... Tennessee

Helton, Sally M., M.S.N. .......... Tennessee

Kollar, Mary, Ph.D. .......... Tennessee

Pierce, Margaret, M.S.N. ...... Tennessee

Pulfer, Lisa, Ph.D. ............ Tennessee

THE MASTER'S PROGRAM

The College of Nursing offers the Master of Science in Nursing degree with concentrations in adult health nursing, parent-child nursing, mental health nursing, family nurse practitioner, and nursing administration.

Admission Requirements

1. Meet requirements for admission to The Graduate School.

2. Hold a Bachelor's degree in Nursing from a National League for Nursing accredited program or complete the equivalent of an upper division undergraduate major in nursing in addition to meeting all M.S.N. degree requirements.

3. Have an undergraduate GPA of 3.0 or higher or a GPA of 3.3 for courses in the undergraduate major.

4. Submit scores of the general portion of the Graduate Record Examination.

5. Submit Graduate Program Data Form.

6. Submit Graduate School Rating Forms from three individuals familiar with the applicant's current work performance or academic aptitude.

7. New students normally are admitted to the program only at the beginning of fall semester. However, under special circumstances and on a space-available basis, a B.S.N. graduate may be admitted at the beginning of spring or summer terms in a temporary non-degree status. Applications for fall admission must be received by February 15.

Special Requirements

1. Each student must hold personal professional liability insurance.

2. Registered nurses must be licensed to practice nursing in the state in which they will be enrolled in courses.

3. Each student must present proof of satisfactory practice in all clinical areas.

4. Each student must present evidence of current 2-person CPR certification.

5. Non-registered nurse students must have completed courses in chemistry, nutrition, microbiology, anatomy, and physiology plus 12 semester hours of behavioral science courses.

Thesis and Non-Thesis Options

The thesis option is available for students who are interested in research. Students who choose the thesis option must register for 580 Nursing Project or 582 Supervised Research.

Program Requirements

All students must complete a minimum of 36 semester hours distributed as follows:

Core (12 credits)

503-04 Holistic Nursing 6

510 Theoretical Foundations of Nursing 3

520 Nursing Resource Management 3

Research (9-12 credits)

--- Graduate level statistics course 3

501 Nursing Research: Methods, Design & Analysis 3

500 Thesis 6

580 Nursing Project 3

582 Supervised Research 3

Concentration (12 credits) -- choose one

530-31 Adult Health Nursing I, II 12

540-41 Family Nurse Practitioner I, II 12

550-51 Parent-Child Nursing I, II 12

560-61 Mental Health Nursing I, II 12

590-91 Nursing Administration I, II 12

Elective (3 credits) -- waived for those who choose thesis option 3

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

301 Clinical Pharmacology 3

304 Introduction to Professional Nursing 5

304 Nursing Assessment and Health Promotion 4

306 Health Deviation Concepts I 3

311 Acute Care Nursing 10

316 Health Deviation Concepts II 4

324 Nursing of Children and Adults 6

414 Community Mental Health Nursing 6

415 Family/Community Health Nursing 6

Registered nurses whose bachelor's degrees are not in nursing must have complete courses in chemistry, nutrition, microbiology, anatomy, and physiology plus 12 hours of behavioral science courses. They must also complete 304, 305, 313, 515, and 403 and complete or successfully challenge the following:

301 Clinical Pharmacology 3

306 Health Deviation Concepts I 4

316 Health Deviation Concepts II 4

325 Nursing of Children and Adults 6

402 Family Health Nursing Theory 3

412 Psychosocial Long Term Nursing Theory 3

Final Examination Requirements

All students must successfully complete a final examination as required by The Graduate School. For thesis students, the examination will consist of an oral defense of their 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

1. 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.

2. 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.

3. 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.

THE DOCTORAL PROGRAM

The College of Nursing offers a doctoral program leading to the Doctor of Philosophy degree with a major in Nursing. This is a unified program offered jointly with The University of Tennessee, Memphis College of Nursing. Students may complete all or part of the program at either site. 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:

1. Analyze, test, refine, extend, and expand the theoretical basis of nursing practice.

2. Conduct nursing research that generates knowledge and advances nursing as a discipline.

3. Provide leadership as nurse researchers, educators, and/or administrators in current and emerging health care settings.

4. Collaborate with members of other disciplines in health-related research of mutual concern.

5. Analyze, develop, and recommend health care policy at various levels.

Admission Requirements

1. Meet requirements for admission to The Graduate School.

2. Hold a master's degree in nursing from a program accredited by the National League for
Nursing. 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.

3. Have a minimum cumulative graduate grade-point average of 3.3 on a 4.0 scale for previous college work.

4. Have a cumulative score of at least 1000 on the verbal and quantitative sections of the Graduate Record Examination.

5. Have successfully completed a basic statistics course and graduate nursing theory and research courses prior to enrollment in nursing doctoral level courses.

6. Have TOEFL scores of at least 550 if native language is not English.

7. Complete Graduate Program Data Form, College of Nursing.

8. Submit Graduate School Rating Forms from three academic references, including instructors and/or nurses and administrators who have supervised applicant's professional work.

9. Submit a sample of scholarly writing (e.g., thesis, published paper).

10. Submit an essay describing personal and professional aspirations.

11. Submit Graduate Application for Admission, academic transcript(s), Graduate Record Examination scores, and, if required, TOEFL scores to the Graduate School. Submit three Graduate School Rating Forms, sample of scholarly writing, and Graduate Program Data Form with essay to the Director of the PhD program prior to February 15.

12. Schedule a personal interview with the College of Nursing PhD Student Admissions Committee prior to March 15 of the year preceding Fall admission.

Program Requirements

The following courses are required for all students:

- 620 Directed Research 3
- 601-6 Theory Analysis & Construction I, II 6
- 605-6 Nursing Research Seminar 4
- 604 Qualitative Nursing Research 3
- 608 Quantitative Nursing Research 3
- 610 Nursing Science Seminar 2
- 611 Advanced Nursing Seminar 2
- 614 Nursing Preceptorship 3
- --- Statistics 3
- --- Electives 12
- 600 Dissertation 24

TOTAL 68

Possible cognate areas include, but are not limited to, anthropology, child and family studies, psychology, education, management, medical ethics, 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 advisor will chair the student's comprehensive examination committee which consists of the faculty teaching core courses and one representative from the cognate area. The student then selects the dissertation committee. Five 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 two members of the committee must be from an academic unit other than nursing.

MINOR IN GERONTOLOGY

Graduate students in the College of Nursing may pursue a specialized minor in gerontology. This interdisciplinary minor gives the student an opportunity for combining knowledge about aging in American society with his/her major concentration. Please refer to Human Ecology for specific requirements.

ACADEMIC COMMON MARKET

An agreement among southern states for sharing graduate programs allows legal residents of certain states to enroll in certain programs at UT Knoxville on an in-state tuition basis. The Ph.D. program in Nursing is available to residents of the states of Alabama or Arkansas. Additional information may be obtained from the Admissions Specialist in the Office of Graduate Admissions and Records.

GRADUATE COURSES

500 Thesis (1-15) P/NF only. E

501 Nursing Research: Methods, Design, and Analyses (3) Prerequisite, knowledge of research issues and their interrelationships in planning, implementation, and evaluation of nursing and health-related research. Investigation of computer applications to data analysis. Prereq or coreq: Graduate level statistics course, 510. F, Sp

502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester in which he/she uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only. E


504 Holistic Nursing: Illness (3) Exploration, analysis, and application of principles of holistic nursing of clients with acute and chronic pathophysiological illness; mind-body influences and interactions. Prereq: Nursing Assessment and Wellness Promotion and Physiological Principles or equivalents. Prereq or coreq: 503. F

505 Advanced Clinical Pharmacology (3) Pharmacological agents utilized to treat acute, recurrent, and chronic health problems. Indications, contraindications, side and interactive effects of commonly prescribed drugs. Prereq: 301 or equivalent or consent of instructor. F

509 Graduate Seminar in Public Health (1) (Same as Public Health 509, Exercise Science 509, Nutrition 509, and Social Work 509.)

510 Theoretical Foundations of Nursing (3) Historical evolution of nursing science: examination and critical analysis of nursing's metaparadigm and selected conceptual models, philosophies, and theories; contemporary ethical theories and application to nursing practice dilemmas. F, Sp

520 Nursing Resource Management (3) Selected organizational, conflict management, decision-making, leadership, professional development, and teaching principles, and concepts applicable to advanced clinical nursing practice. F, Sp

530 Adult Health Nursing I (6) Exploration and application of advanced nursing, physiological, developmental, and psychosocial theories to nursing care and management of clients and their families who are experiencing episodes of acute and chronic illnesses and related crises; role of clinical nurse specialist in helping clients and families achieve optimal wellness. Prereq: 504. Prereq or coreq: 501, 520. 2 hrs and 4 labs. Sp

531 Adult Health Nursing II (6) Further emphasis on role of clinical nurse specialist in providing and managing nursing care for acutely and chronically ill adults across life span; exploration, analysis, and application of selected advanced management, supervisory, organizational, and leadership theories; application of health-related concepts and research to implementation of clinical nurse specialist role. Prereq: 530. 2 hrs and 4 labs. F

540 Family Nurse Practitioner I (6) Exploration and application of holistic nursing theories to nursing management of common health problems of individuals and their families; opportunities for clinical practice in role of nurse practitioner in variety of settings. Prereq: 504. Prereq or coreq: 501, 520. 2 hrs and 4 labs. Sp

541 Family Nurse Practitioner II (6) Continuation of 540. Seminar and clinical practicum: management of chronic health problems in all developmental life stages; role refinement and exploration of major issues in delivery of primary nursing care; clinical experiences in variety of settings. Prereq: 540. 2 hrs and 4 labs. F

543 Nurse Practitioner (9) Exploration and application of holistic nursing concepts to nursing management of common and chronic health problems. Role refinement and exploration of major issues in delivery of holistic primary nursing care. Clinical experiences vary depending on student's intent to pursue certification as family or adult nurse practitioner. Prereq: 541. 6 hrs in concentration, 505 or equivalent, and consent of instructor. 3 hrs and 6 labs. Su

550 Parent Child Nursing I (6) Exploration and application of selected advanced nursing, physiological, psychological, developmental, environmental, cultural, and other theories, principles, and concepts to child-bearing or child-rearing families in acute care or community settings, family wellness, and interventions designed to recognize and respond to wellness of mothers, neonates, children, and adolescents. Prereq: 504. Prereq or coreq: 501, 520. 2 hrs and 4 labs. Sp

551 Parent Child Nursing II (6) Continuation of 550. Seminar and clinical practicum: designed to facilitate further development of specialized knowledge and skills used for advanced practice. Role refinement of clinical nurse specialist or nurse practitioner in management of women and child-bearing or child-rearing families in community, hospital, or other health care settings. Prereq: 550. 2 hrs and 4 labs. F

552 Parent Child Nursing Field Work and Seminar (5) Seminar and intensive clinical practicum designed to facilitate further development of specialized knowledge and skills utilized for advanced parent-child nursing practice. Prereq or coreq: 551. 1 hr and 4 labs. Sp

557 Nurse Midwifery Seminar I (6) Exploration of art and science of midwifery, nature and scope of midwifery practice, professional and ethical issues in midwifery practice. Prereq or coreq: 501, 510. F


560 Mental Health: Nursing I (6) Exploration and application of advanced theories of therapeutic nursing intervention to clients experiencing mental health problems. Options for clinical practice with clients of various age groups in acute care or community facilities. Prereq: 504. Prereq or coreq: 501, 520. 2 hrs and 4 labs. Sp

561 Mental Health Nursing II (6) Continuation of 560. Groups and families with mental health problems. Seminar and clinical practicum designed to focus on advanced practice and development of specialized knowledge and skills. Prereq: 560. 2 hrs and 4 labs. F

566 Teaching Practicum (1-6) Individually designed teaching experience in collegiate nursing program or nursing practice setting. Objectives, activities, and faculty development coordinated by student and faculty. Prereq or coreq: 564 and consent of instructor. S/N or letter grade. Sp

568 Educational Principles and Strategies (3) Exploration and analyses of selected education, curriculum, teaching-learning, measurement, and evaluation prin-
ciples and theories as applied to instruction of undergraduate nursing students, staff development, and patient education under the supervision of an instructor. Su

577 Special Topics (1-3) Topic is determined by faculty and student interest. Prereq: Consent of instructor. May be repeated. Maximum 6 hrs. E

580 Nursing Project (3) Research culminating in scholarly paper. Student initiated project with faculty permission, small research utilization project, pilot study, or "state of the science" paper in clinical area. Original research projects may require human subject approval in prior semester or extension to two semesters. Prereq: Consent of instructor, 501, 510. May be repeated. Maximum 6 hrs. E

582 Supervised Research (3) Supervised research culminating in scholarly paper. Experiential learning of research process. Participation in on-going faculty research projects. Prereq: Consent of instructor, 501, 510. May be repeated. Maximum 6 hrs. E

583 Directed Clinical Practice (1-9) Additional opportunities for advanced nursing practice. Objectives to be developed collaboratively by student and faculty. Prereq: Enrollment in or completion of graduate level courses in clinical nursing. Maximum 9 hrs. S/N/C or letter grade. E

585 Seminar in Gerontology I (3) (Same as Sociology 585, Counselor Education and Counseling Psychology 585, Exercise Science 585, Public Health 585, Psychological Educations 585, Social Work 585, and Sociology 585.)

590 Nursing Administration I (6) Exploration, analysis and application of selected organizational, management, and leadership theories and financial principles to delivery of nursing services. Structure, functions, organization, behavior, and administrative processes of health care organizations. Prereq: 504, 505 or coreq: 501, 502, 6 hrs and 4 labs. Sp

591 Nursing Administration II (6) Continuation of 590. Utilization of human and financial resources, conflict resolution, and organizational development with application to mid- and top-level nursing administration positions. Prereq: 550, 2 hrs and 4 labs. F

593 Independent Study (1-3) Prereq: Consent of instructor. May be repeated. Maximum 6 hrs. E

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

601-02 Theory Analysis and Construction I, II (3,3) Nursing theory analysis and synthesis of existing health and nursing theories; theory building from existing knowledge. Prereq: 510 or equivalent or consent of instructor. F, Sp

605-06 Nursing Research Seminar (2,2) Selected topics pertaining to dissertation proposal process, research experience, and defense. Prereq: Completion of core courses. F, Sp

607 Qualitative Nursing Research (3) Exploration and analysis of philosophical bases, theoretical implications, methods, and data analyses of qualitative nursing research. F

608 Quantitative Nursing Research (3) Exploration and analysis of philosophical bases, theoretical implications, methods, and data analyses of quantitative nursing research. Prereq or coreq: Graduate level statistics course. F

609 Research Practicum (1-3) Supervised individual or group research experience under guidance of faculty. Prereq: Consent of instructor. May be repeated. Maximum 12 hrs. S/N/C or letter grade. E

610 Nursing Science Seminar (2) Critical Analysis and synthesis of literature in selected focus area within nursing science. Prereq: Admission to doctoral program in nursing or consent of instructor. Sp

611 Advanced Nursing Seminar (2) Exploration of historical and current issues of interest to doctoral prepared nurses. F

612 Health and Nursing Policy/Planning (3) Policies affecting nursing education and practice, health policies and political processes, interactions between health professionals, consumer groups, and government in health policy development and health planning activities. Sp

613 Nursing Management of Complex Systems (3) Contemporary organizational and management theories and techniques needed for effective administrative leadership in nursing education, practice, research, and entrepreneurial settings. F

614 Nursing Preceptorship (3) Individually-designed practicum, field, or internship experience in various of administrative, educational, research, or clinical practice settings. Prereq: 510, 515, 520, 540, 541, 542, 543, 544, 545. F

620 Directed Research (3) Exploration of theoretical considerations and research methodologies in nursing research with completion of study under faculty guidance. Prereq: Consent of instructor. May be repeated. Maximum 6 hrs. Sp

Nutrition

(Majors in Human Ecology)

MAJORS

DEGREES

Nutrition (College of Human Ecology) M.S.

Foodservice and Lodging Administration ... M.S.

Human Ecology ................................ Ph.D.

Michael B. Zemel, Head

Professors:

Beauchene, Roy E. (Emeritus), Ph.D. ......................................................... Kansas State

Carruth, Betty Ruth, Ph.D. ................................................................. Missouri

Sachan, Dillep S., Ph.D. ................................................................. Illinois

Smith, John T. (Emeritus), Ph.D. ................................................................. Oregon State

Zemel, Michael (Liaison), Ph.D. ................................................................. Wisconsin

Associate Professors:

Allam, Youssri, Ph.D. ................................................................. Tennessee

Bailey, James W., Ph.D. ................................................................. Iowa State

Brooks, M. D. (Memphis), M.S. ................................................................. Alabama

Costello, Carol Ph.D. ................................................................. Tennessee

Haughton, B., Ed.D. ................................................................. Columbus

Powell, J. A. (Memphis), Ph.D. ................................................................. Michigan State

Assistant Professors:

Bittle, Joyce (Memphis), Ph.D. ................................................................. Tennessee

Chencherick, Janet (Memphis), M.S. ................................................................. Maryland

McGrath, M. (Liaison), Ed.D. ................................................................. Tennessee

Monstad, Naima, Ph.D. ................................................................. Paris

Young, Katherine A., J.D. ................................................................. California Western School of law

Instructor:

Jones, K., MBA ................................................................. East Texas State

Wayne State

Master of Science programs are available in Nutrition and in Foodservice and Lodging Administration. Within the Nutrition program, a student may choose a concentration in nutrition science or public health nutrition. A graduate degree is combined with an approved pre-professional practice experience (AP4) beyond the baccalaureate degree requires that the graduate apply for the Registration Examination to become a Registered Dietitian (R.D.). Students may request more information from the department about the AP4 program. Students may also select an interdisciplinary minor in gerontology.

ADMISSION REQUIREMENTS

A final file for review includes the Graduate School application form, completed departmental application form, Graduate Record Examination (GRE) scores for the general section, and three Graduate School Rating Forms completed by individuals who can attest to the applicant's potential for graduate education. Forms may be obtained from the Department Office, 229 Jesse Harris Building, University of Tennessee, Knoxville, 37996-1900.

Admission into any of the graduate programs in the department is dependent on completion of undergraduate courses that give the necessary background for success in the graduate program. For programs in Nutrition, essential undergraduate courses include: general and organic chemistry, physiological chemistry, physiology, statistics and advanced nutrition. For the master's program in Foodservice and Lodging Administration, undergraduate courses in foodservice and lodging administration, quantity food production, cost control, marketing, and personnel development are essential. Applicants to all programs with related work experience may be given preference.

THE MASTER'S PROGRAM

Students may choose a thesis or non-thesis option in Nutrition or Foodservice and Lodging Administration. Attendance at HRA 537 (Foodservice and Lodging Administration) or NTR 540 (Nutrition) is required every semester.

Nutrition

Thesis Option: The program consists of a minimum of 33 hours with at least 16 hours of coursework in the department. NTR 511, 512, 540, 541 and 3 hours of graduate level statistics are required. Students in public health nutrition must take 511, 512, 513, 514, 515, 541 and the minor in public health. Six hours of Thesis 500, and 6 hours outside the department are required. A minimum of 22 hours at the 500 and 600 level is required.

An oral comprehensive examination is required upon completion of the thesis.

Non-Thesis Option: The program consists of a minimum of 36 hours with at least 20 hours of coursework in the department. NTR 511, 512, 540, 541, 2 hours from 542-544 and 3 hours of graduate level statistics are required. Students in public health nutrition must take 511, 512, 513, 514, 515, 541 and the minor in public health. Six hours in one area outside the department are required. A minimum of 24 hours at the 500 and 600 level is required.

A written comprehensive examination is required for completion of the program.

Foodservice and Lodging Administration

Thesis Option: The program consists of a minimum of 33 hours with at least 16 hours of coursework in the department. HRA 537, 546, NTR 541, and 3 hours of graduate-level statistics are required. Six hours in one area outside the
Nutrition

GRADUATE COURSES

414 Nutrient-Drug Interactions (2) Nutrient effects on efficacy and toxicity of therapeutic drug agents on absorption and metabolism of nutrients. Prereq: Fundamentals of Nutrition or equivalent. Sp,A

500 Thesis (1-15) P/NP only. E

502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only. E

508 Culture, Food, and Nutrition (3) Food-related behavior of individuals and groups in United States. Sociocultural, economic, and technological influences. Nutrition and food surveys, public policy. Prereq: Nutrition for Educators or Advanced Nutrition or consent of instructor. F,A

509 Graduate Seminar in Public Health (1) (Same as Public Health 509, Exercise Science 509, Nursing 509 and Social Work 509.)

511 Advanced Physiological Chemistry (4) Bioenergetics; flux control and hormonal interrelationships. Prereq: Advanced Nutrition or equivalent. F


513 Community Nutrition I (3) Orientation to community; assessment of nutrition problems, needs, and resources. Application of health nutritionist. Concurrent field experiences. Prereq: Advanced Nutrition or consent of instructor. F

514 Community Nutrition II (3) Planning, implementation, and evaluation of public health nutrition programs. Concurrent field experiences. Prereq: 513 or consent of instructor. Sp

515 Field Study in Community Nutrition (1-12) Personal participation in and analysis of state or regional community nutrition program. Location of in-depth study to be selected in consultation with instructor. Prereq: 513, 514 and consent of instructor. S/NC only. Su

516 Maternal and Child Nutrition (3) Nutrition principles related to growth and development during pregnancy, infancy, and childhood to age 5, high risk conditions. Prereq: Advanced Nutrition or consent of instructor. F

517 Childhood and Adolescent Nutrition (3) Application of nutrition principles to school age children; effects of diseases on growth and health maintenance; nutritional assessment and counseling for nutrition. Prereq: Advanced Nutrition or consent of instructor. Sp,A

518 Nutrition and Aging (2) Nutritional problems of adults; nutritional requirements, dietary intakes; affects of nutrition on biological aging. Prereq: Advanced Nutrition or consent of instructor. Su

520 Nutritional Ecology (2) Examination of issues in natural, political, physical, and social environments that impact availability of food and nutrients in U.S. food supply. F,A

521 Physiological Basis for Diet and Disease (2) Altered nutrient needs as result of metabolic changes that occur in selected disease states. Prereq: Nutrition in Disease or consent of instructor. Sp

522 Nutrition Counseling (2) Individual eating habits and disorders, evaluation strategies for effectiveness of helping process. Prereq: Nutrition in Disease or consent of instructor. F,A

524 Nutrition Education: Principles, Implementation, and Evaluation (3) Conceptual models, principles, applications, and evaluation models in nutrition education research. Prereq: 508 or consent of instructor. Su,A

540 Seminar in Nutrition (1) May be repeated. S/NC only. E

541 Research Methods (1) Basic principles of planning, conducting, and interpreting nutrition and foodservice systems administration research. Prereq: 6 graduate hrs in nutrition and foodsystem administration and statistics. Sp

542 Advanced Experimental Nutrition (2) Application of research principles to individual project using experimental animals. Prereq or coreq: 541. Sp

544 Food and Nutrition Survey Methods (2) Project for assessment of food consumption, nutrient intake, nutritional status, and sociocultural economic parameters in populations. Prereq or coreq: 541. Sp

547 Field Experience (3-9) Experiences in food-related industry or agency under supervision of faculty member. Prereq: Consent of instructor. S/NC only. E

548 Directed Study in Nutrition (1-3) Advanced study in nutrition. Prereq: Consent of instructor. May be repeated. Maximum 6 hrs. E

560 Special Topics (1-3) Recent advances in nutrition or food systems administration. Prereq: Consent of instructor. May be repeated. Maximum 6 hrs. E

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

602 Advanced Topics in Nutrition Science (1-3) Comprehensivestudy of individual topics and group discussion of topics related to current problems in nutrition. Prereq: 512 or consent of instructor. May be repeated. F

603 Current Trends in Food and Sociocultural Change (2) Critical evaluation of research. Prereq: 508 or consent of instructor. F,A

The Ph.D. Concentrations

Nutrition Science

The Nutrition science concentration enables students to study the science of nutrition from the cellular level to the application of nutritional principles by people in a changing environment.

The doctoral program emphasizes human nutrition, nutritional epidemiology, experimental nutrition, and intermediary metabolism. Cognate areas may include anthropology, biochemistry, chemistry, communications, education, food technology, human development, physiology, public health, sociology, statistics, and/or toxicology.

Minimum requirements include:
- Sixteen hours in nutrition including 4 hours at the 600 level (exclusive of dissertation);
- Two courses, NTR 511, 512, 514, and 2 hours from either 542-544;
- Three hours of NTR 540, attendance required every semester;
- Professional seminar, HE 601;
- Six hours of statistics;
- Six hours in a cognate area;
- Nine hours at the 600 level;
- Students without college teaching experience are required to take the fall semester teaching seminar for GTAs and NTR 548 comprising a faculty-supervised problem in college teaching.

Consumer Environments

Students enrolled in the Ph.D. program with a concentration in consumer environments are provided with a foundation of coursework relevant to understanding the consumer in the designed environment and management of facilities. From this base, students in foodservice and lodging administration focus on areas of specialization in foodservice systems and in lodging administration to further theory and the application of theory in the field. For further information, see consumer environments concentration under Human Ecology.

ACADEMIC COMMON MARKET

An agreement among southern states for sharing graduate programs allows legal residents of some states to enroll in certain programs at UT Knoxville on an in-state tuition basis. The M.S. program in Foodservice and Lodging Administration is available to residents of the states of Arkansas or West Virginia. The M.S. program in Nutrition is available to residents of Arkansas or Virginia. Additional information may be obtained from the Admissions Specialist in the Office of Graduate Admissions and Records. For the Ph.D., see Human Ecology.
Ornamental Horticulture and Landscape Design

(College of Agricultural Sciences and Natural Resources)

**MAJOR**

Ornamental Horticulture and Landscape Design ...................... M.S.

G. Douglas Cramer, Head

Professors:

Callahan, L. M., Ph.D. ................. Rutgers
Crater, G. Douglas, Ph.D. .......... Ohio State
Graham, E. T., Ph.D. ............... Penn State
Grasshoff, Peter M. (Racheff Chair).
Ph.D. .................................. Australian National
McDaniel, G. L., Ph.D. .............. Iowa State
Williams, Don B., Ph.D. .......... Penn State

Associate Professors:

Augé, Robert M., Ph.D. ................. Washington State
Day, J. W., Ph.D. ..................... Mississippi State
Rogers, S. M., M.L.A. ................. Georgia
Trigiano, R., Ph.D. .................. NC State
Witte, Willard T. (Liaison), Ph.D. .......... Maryland

Assistant Professor:

Starman, Terri W., Ph.D. ............ Texas A&M

The Department of Ornamental Horticulture and Landscape Design offers the Master of Science with concentrations in floricultural science and technology, nursery science and technology, or turfgrass science and technology. Various interests may be emphasized in any of these commodity areas, including micropropagation, innovative production and maintenance systems, computer-aided management systems, and the molecular biology, genetics, histology and stress physiology of ornamentals.

For admission, the student must have a B.S. in ornamental horticulture, horticulture, plant science, or a related agricultural or basic science discipline. Undergraduate transcripts must be evaluated by the department for prerequisite requirements, if any. Graduate research assistantships are available on a competitive basis. For further information, contact the department head.

**THE MASTER’S PROGRAM**

**Thesis Option**

1. A thesis is required. A master’s committee of no fewer than 3 faculty members will be selected. Prior to research for the thesis, a proposal must be approved by the master’s committee. Registration for 6 hours of Thesis 500 is required.

2. In addition to the thesis requirement, a minimum of 24 hours of graduate credit is required. Not more than 10 hours of the minimum 30 hours can be below the 500 level. The academic program must be approved by the master’s committee which may require additional course work if the student’s progress or background indicates such need.

3. All students are required to include 510 Research Methods and 2 hours of 590 Seminar in their program and are expected to attend the course and participate in discussions each semester enrolled.

4. Twelve hours of coursework in the major must be at the graduate level, exclusive of Thesis 500.

5. An oral examination covering the thesis and coursework is required.

**Non-Thesis Option**

1. A master’s committee of no fewer than 3 faculty members will be selected.

2. Thirty-four hours of graduate coursework are required of which 22 hours must be at the 500 level or above.

3. All students are required to include 2 hours of 590 Seminar in their program and are expected to attend this course and participate in discussions each semester enrolled.

4. Twelve hours of coursework in the major must be at the graduate level.

5. Final comprehensive written and oral examinations shall be taken upon completion of no fewer than 32 hours of approved graduate work.

**GRADUATE COURSES**

**410** Nursery Management and Production (3) Modern management methods as applied to retail and wholesale nurseries and landscape contracting firms. Methods of producing liners, container and field-grown woody ornamental plants. Prereq: 220, 330, and Plant and Soil Science 210, or consent of instructor. 2 hrs and 1 lab. Sp

**420** Advanced Floriculture Science and Technology (3) Physiology and greenhouse production of floriculture crops. Cultural practices: propagation, planting, spacing, fertilization, temperature and daylength regimes, harvest, shipping, marketing, and pest control. Prereq: Greenhouse Production and Management or consent of instructor. 2-4 hr labs. Sp

**440** Advanced Turfgrass Management (4) Principles and scientific basis of turfgrass culture: adaptation, ecology, physiology, soil fertility, and grass nutrition, climatic influences on grass culture; physiology of clipping and watering, management design, construction, and management of golf courses; and physiological influences of past infestation and control measures. Prereq: 340 or consent of instructor. 3 hrs and 1 lab. Sp

**451** Plant Tissue Culture (3) (Same as Botany 451.)

**460** Professional Practices in Landscape Construction and Management (2) Professionalism, salesmanship, proposal, bidding, estimating, specification, and contract management in landscapes services industry. Interaction with industry representatives through special presentations. Prereq: 350 or consent of instructor. F

**480** Advanced Landscape Design (4) Comprehensive application of landscape design skills. Design applications involving site layout, landscape grading, applied landscape construction, planting design; analysis, programming, detail design, estimating, and specifying appropriate to various landscape projects. Prereq: 280, 350, and 380, or consent of instructor. 1 hr and 2-3 hr labs. Sp

**485** Computer Aided Landscape Design (3) Overview of drafting and design (CAD). Site planning and construction of related landscape plan view and 3-D drawings. Introduction to operating systems; techniques on utilization of AutoCAD and LANDCAD software. Prereq: Fundamentals of Landscape Design, Microcomputer Applications to Problem Solving or consent of instructor. 2-3 hr labs. F, Sp

**500** Thesis (1-15) P/NP only. E

**501** Special Topics in Ornamental Horticulture and Landscape Science (1-3) Topics to be assigned. May be repeated. Maximum 6 hrs. Prereq: Consent of Instructor. E

**502** Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/N only. E

**510** Research Methods in Ornamental Horticulture and Landscape Design (2) Literature retrieval, research proposal writing; use of computers for word processing, data entry, statistical analysis, and graphics production. Required of all students in thesis option. Prereq: Plant and Soil Science 471. F

**511** Plant Disease Fungi (4) (Same as Entomology and Plant Pathology 510.)

**550** Microtechnique (3) Methods of investigating histostructure, histochemistry, ploidy, and pathological structures in ornamental and crop plants, light microscopy. Prereq: 8 hrs biological science, 8 hrs chemistry, and consent of instructor. 1 hr and 2 labs. Sp

**570** Physiology and Development of Ornamental Plants (3) Basic and applied physiology of ornamental plants related to growth and development in production and utilization. Critical review of literature and discussion of juvenility and phase change, flowering, photoperiodism, vernalization, cold acclimation, hardiness, dormancy, growth regulators, environmental stress, and post-harvest considerations. Prereq: Botany 321 and consent of instructor. Sp

**590** Seminar (1) Current literature and developments. May be repeated. Maximum 3 hrs. E

**593** Problems in Ornamental Horticulture and Landscape Science (1-3) Independent study. Current topic related to technology and science. May be repeated. Maximum 6 hrs. E

**Pathology**

See College of Veterinary Medicine and Comparative Experimental Medicine

**Philosophy**

(College of Arts and Sciences)

**MAJOR**

Philosophy .................................. M.A., Ph.D.

George G. Brenkert, Head

Professors:

Aquila, Richard E., Ph.D. ............... Northwestern
Brenkert, George G., Ph.D. .......... Michigan
The Department of Philosophy offers graduate study leading to the Master of Arts and Doctor of Philosophy. The M.A. program includes thesis and non-thesis options and offers concentrations in medical ethics and in religious studies. The Ph.D. program also has a concentration in medical ethics. Detailed information may be obtained from the Director of Graduate Studies in Philosophy.

**THE MASTER'S PROGRAM**

The department offers both a thesis and a non-thesis option. The course requirements for an M.A. with thesis are 30 hours, including 6 hours in Philosophy 500. Of non-thesis hours, at least two-thirds must be in courses at or above the 500 level. No philosophy course numbered under 400 may be taken for graduate credit. There are no particular courses that M.A. students are required to take. The nature of the student's coursework should be determined in consultation with the student's faculty committee.

The non-thesis M.A. requires 30 hours of coursework of which at least two-thirds must be in courses at or above the 500 level. Students seeking the non-thesis option must also pass a final written examination on all work offered for the degree. An additional oral examination may be required.

**THE DOCTORAL PROGRAM**

Students must hold an M.A. with a major in Philosophy or an equivalent degree when entering the Ph.D. program. Twenty-seven hours of coursework beyond the M.A. is required, of which 6 hours will be in courses numbered above 600. See the Philosophy Department Graduate Student Procedures for specific course requirements.

Students must demonstrate a reading knowledge of one foreign language, normally a living language in which there exists a significant body of philosophical literature. In special circumstances relating to the area of dissertation research, the Graduate Committee may approve a language not satisfying these conditions.) This may be done by passing the doctoral language examination given by the appropriate department, if available, or by passing French 302 or German 332 with a B or better. Bi- or multilingual (normally, foreign) students, whose native language (other than English) is one in which there is a significant body of philosophical literature, are exempted from the foreign language requirement. Students receiving the Ph.D. with concentration in medical ethics are also exempted.

**CONCENTRATIONS**

**Medical Ethics**

The department has an M.A. and Ph.D. program of graduate study with a concentration in medical ethics. Detailed information concerning the program may be obtained from either the Director of Graduate Studies in Philosophy or the Director of the Medical Ethics Program.

**Religious Studies**

The department has an M.A. program of graduate study with a concentration in religious studies. Details concerning the program may be obtained from either the Director of Graduate Studies in Philosophy or the Department of Religious Studies.

**ACADEMIC COMMON MARKET**

An agreement among southern states for sharing graduate programs allows legal residents of some states to enroll in certain programs at UT Knoxville on an in-state tuition basis. The M.A. and Ph.D. programs in Philosophy are available to residents of the states of Alabama and West Virginia; Kentucky, Texas, or Virginia (concentration in medical ethics only); the Ph.D. program to residents of Arkansas (concentration in medical ethics only); Louisiana, or Mississippi; and the M.A. program to residents of Oklahoma (concentration in medical ethics only). Additional information may be obtained from the Admissions Specialist in the Office of Graduate Admissions and Records.

**GRADUATE COURSES**

**400 Special Topics (3)** May be repeated when topic varies. Maximum 6 hrs.

**411 Modern Religious Philosophies (3)** (Same as Religious Studies 411)

**412 Classical Indian Systems of Philosophy: The Moksha Tradition (3)** (Same as Religious Studies 412)

**420 Topics in History of Philosophy (3)** Figures or movements from antiquity through mid-twentieth century. Prereq: 6 hrs of philosophy or consent of instructor. May be repeated when topic varies. Maximum 9 hrs.

**425 American Philosophy (3)** Colonial to early 20th Century. Prereq: 6 hrs of philosophy or consent of instructor.

**435 Intermediate Formal Logic (3)** Metaphysics of formal logic and philosophy of logic. Prereq: Consent of instructor.

**440 Contemporary Ethical Theory (3)** Topics in metaethics or ethics. Prereq: 6 hrs of philosophy or consent of instructor.

**445 Theoretical Issues In Medical Ethics (3)** Prereq: 240 or 245 and 1 yr of natural or social science, or consent of instructor.

**450 Philosophy of Science (3)** Methodological and conceptual issues in natural and social sciences; patterns of theory modification and replacement, nature of explanation and causation, status of theoretical entities. Prereq: 360 and 1 yr of natural or social science, or consent of instructor.

**455 Philosophy of History (3)** Speculative and critical aspects of philosophy of history. Prereq: 6 hrs of philosophy or consent of instructor.

**473 Philosophy of Mind (3)** Problems of mind and body in relation to concepts of consciousness and personal identity. Prereq: 8 hrs of philosophy or consent of instructor.

**475 Analytic Metaphysics and Epistemology (3)** Topics in metaphysics and epistemology in recent Anglo-American tradition. Prereq: 6 hrs of philosophy or consent of instructor.

**479 Studies in Recent Continental Philosophy (3)** Selected thinkers or topics: existentialism, phenomenology, hermeneutics, structuralism, post-structuralism. Prereq: 6 hrs of philosophy or consent of instructor. May be repeated when topic varies. Maximum 6 hrs.

**500 Thesis (1-15)** P/NP only. E

**502 Registration for Use of Facilities (3-15)** Required of all graduate students except those at one or more local health care institutions. Open only to graduate students concentrating in medical ethics. Prereq: Consent of instructor or by departmental permission. May be repeated. Maximum 9 hrs.

**540 Topics in Ethics or Value Theory (3)** May be repeated. Maximum 6 hrs.

**542 Topics in History of Ethics (3)** Dominant movements in history of ethics. May be repeated. Maximum 9 hrs.

**544 Topics in Applied Ethics (3)** Single author, traditional, or topical ethical theory. Application to issues in medical ethics. Prereq: Consent of instructor or by departmental permission. May be repeated. Maximum 9 hrs.

**545 Orientation to Medical Ethics (3)** Survey of ethical theories in application to issues in medical ethics.

**547 Ethical Issues in Mental Health (3)** Values in “mental health” and “mental illness,” informed consent in psychotherapy, competence, patients’ rights, involuntary hospitalization and treatment, and behavior control therapies.

**548 M.A. Clinical Practicum (3)** Series of clinical rotations at one or more local health care institutions. Open only to graduate students concentrating in medical ethics. Prereq: Consent of instructor or by departmental permission. May be repeated. Maximum 9 hrs.

**560 Topics in the Philosophy of Science (3)** Nature of subject matter and method of science. May be repeated. Maximum 9 hrs.

**577 Topics in Philosophy of Mind (3)** Relation of mental to physical and of role of words in discourse for mental activities, thinking and feeling. May be repeated. Maximum 9 hrs.

**578 Advanced Clinical Medical Ethics (3)** Critical concepts in medical ethics, relationship of theory to practice, and professional roles and responsibilities for health care ethics consultants. Open only to Ph.D. students concentrating in medical ethics. Prereq: Consent of instructor or by departmental permission. May be repeated. Maximum 9 hrs.

**585 Special Topics (3)** May be repeated. Maximum 9 hrs.

**587 Problems in Social and Political Philosophy (3)** Philosophical problems concerning social and political life: family, state, freedom, justice; major theoretical responses: anarchism, social contract, Marxism. May be repeated. Maximum 6 hrs.

**591 Foreign Study (1-15)** See College of Arts and Sciences.
Physicists and Astronomy

College of Arts and Sciences

MAJOR

DEGREES

Physics: M.S., Ph.D.

William M. Bugg, Head

Professors:

Bingham, C.R., Ph.D...............................Tennessee
Blais, W. E., Ph.D................................Michigan State
Breazeale, M. A., Ph.D............................Michigan State
Breinig, M. Ph.D......................................Oregon
Bugg, W. M., Ph.D.................................Tennessee
Burgdoerfer, J. Ph.D...............................Frie Universitat Berlin
Calkott, T. A., Ph.D...............................Purdue
Childs, R. W., Ph.D................................Vanderbilt
Christophorou, L. G., Ph.D........................Manchester
Condo, G. T., Ph.D................................Illinois
Crater, H. W. (UTSI), Ph.D........................Yale
Deeds, W. E. (Emeritus), Ph.D...................Ohio State
Duckett, K. E., Ph.D.................................Tennessee
Eguiluz, Adolfo G., Ph.D..........................Brown
Elston, S. B., Ph.D.................................Massachusetts
Fox, K. Ph.D.......................................Michigan
Galair, N. M. (Emeritus), Ph.D........................Ohio State
Georgiou, S., Ph.D.................................Manchester
Guldich, M. W., Ph.D..............................Tennessee
Hanel, T. H., Ph.D.................................Rutgers
Harris, E. G. (Emeritus), Ph.D........................Tennessee
Hart, E. L. (Liaison), Ph.D........................Cornell
Jacobson, H. C., Ph.D..............................Yale
King, D. T. (Emeritus), Ph.D........................Bristol
Lewis, J. W. L. (UTSI), Ph.D........................Mississippi
Macek, J. (Distinguished Scientist), Ph.D.............................Rensselaer

Selin, I. A. (Chancellor's Research Scholar), Ph.D..............................Chicago
Shih, C., Ph.D......................................Cornell
Sorensen, P. S., Ph.D..............................Copenhagen
Strayer, M. R., Ph.D..............................MIT
Thompson, J. Jr., Ph.D..............................Duke
Thomson, J. O. (Emeritus), Ph.D....................Illinois
Ward, B. L., Ph.D.................................Princeton
Wheeler, G. W. (Emeritus), Ph.D.....................Yale
White, J. W. (Emeritus), Ph.D........................North Carolina

Associate Professors:

Muehlejauser, J. W. (UTSI), Ph.D.........................Tennessee
Sheeh, S. Y., Ph.D.................................Maryland

Assistant Professors:

Carrington, R. Ph.D...............................Tennessee
Duffet, J. Ph.D......................................Queens
Harmatz, R. Ph.D................................Ohio State
Levin, J. C., Ph.D.................................Oregon
Menzel, R. (UTSI), Ph.D........................Tennessee
Parigger, C. (UTSI), Ph.D........................New Zealand
Philips, W. (UTSI), Ph.D........................Tennessee
Read, K. F., Ph.D.................................Cornell
Sanders, A. J., Ph.D................................Tufts
Siopsis, G., Ph.D....................................Cal Tech
Weinberg, H. H., Ph.D. Groningen (Netherlands)

Research Professors:

Kamyakov, I., Ph.D...............................ITEP (Russia)
Zhang, J., Ph.D.................................Lanzhou

Research Associate Professors:

Du, Yuan-Cai, Ph.D..............................Beijing
McCorke, D. L., Ph.D..............................Tennessee
Saini, Suresh, Ph.D...............................Bombay

Research Assistant Professors:

Chen, X., Ph.D......................................Purdue
Datskov, Ph.D. P.................................Tennessee
Davis, L. (UTSI), Ph.D........................Auckland
Efremenko, Ph.D. Y. Y., Ph.D. ITEP(Russia)
Mecazzapica, P. A., Ph.D........................Texas
Ormand, W. E., Ph.D..............................Michigan State
Pinndauwe, L., Ph.D...............................Bristol
Reinhold-Larsson, C. O., Ph.D......................Buenos Aires
Yost, S. A., Ph.D.................................Princeton

Instructors:

Fairman, R. C., B.A.................................Earlham
Readinger, T. M., Ph.D..............................Vanderbilt

Graduate programs leading to the Master of Science and the Doctor of Philosophy are offered in a number of concentration areas:

Atomic and low-temperature physics, biophysics, chemical physics, elementary particle physics, health physics, heavy ion atomic physics, molecular spectroscopy, nuclear physics, plasma physics, condensed-matter physics, theoretical physics, and ultrasonics.

Departmental graduate programs leading to the M.S. and Ph.D. are also available at The University of Tennessee Space Institute, Tullahoma, where opportunities for study and research are available in quantum optics and laser physics, atomic and molecular spectroscopy, fluid physics, and theoretical physics. Additional information, contact the department head.

ADMISSION REQUIREMENTS
302 with a grade of A or B may be substituted for the corresponding language examination.

The dissertation topic will be chosen with reference to one of the fields in which research facilities can be made available either at The University of Tennessee laboratories in Knoxville, The University of Tennessee Space Institute at Tullahoma, Tennessee; the Oak Ridge National Laboratory, Oak Ridge, Tennessee; or at other research facilities used by the University faculty.

**Astronomy**

**GRADUATE COURSES**

411 Astrophysics (3) Development of analytical physical models of galactic structure of universe, stellar and interstellar matter, and planetary systems. Topical and interdisciplinary, consideration of quasars, pulsars, black holes and current developments in field. Acceptable for major credit in physics. Prereq: Physics 232 and 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. May be repeated with consent of department. Maximum 9 hrs.

**Physics**

**GRADUATE COURSES**


421 Modern Optics (3) Transmission of light in uniform, isotropic media; reflection and transmission at interfaces; mathematics of wave motion and interference effects. Requirements for advanced physics and engineering students. Prereq: 451, or Fundamentals of Physics: Wave Motion, Optics, and Modern Physics, or Honors: Mechanics and Heat, and consent of instructor. 3 hrs and 3 labs.

431-32 Electricity and Magnetism (3,3) Electrostatics, magnetostatics, coupled electric and magnetic fields, Maxwell's Equations, electromagnetic waves and radiation. Prereq: Fundamentals of Physics: Wave Motion, Optics, and Modern Physics or Honors: Mechanics and Heat, and consent of instructor. 3 hrs and 3 labs.

451 Techniques of Theoretical Physics (3) Methods and general solutions in potential theory, spectal analysis, wave mechanics, specific Sturm-Liouville systems and other selected techniques of theoretical physics. Must be taken in sequence. Prereq: Fundamentals of Physics: Wave Motion, Optics, and Modern Physics or Honors: Mechanics and Heat, and Calculus III. Coreq: Matrix Algebra I.

461-62 Modern Physics Laboratory (3,3) 461 - Introduction to fundamental and modern techniques in experimental physics, and to theory and practice of measurement and data analysis. Selected experiments in nuclear, atomic, molecular and solid state physics, and modern optics. Prereq: Electronics Laboratory and either Fundamentals of Physics: Modern Physics or 411, 462 - Advanced Meter. Fundamentals of optics and techniques in modern physics; experimental team work. Thorough quantum mechanical interpretation of results and preparation of scientific reports. Prereq: 461. 6 hrs lab per week.

471-72 Health Physics (3,3) Radioactivity, interaction of electromagnetic radiation with matter, radiation quantities and units, point kernel and extended sources, x-rays and gamma rays, neutron activation, interaction of charged particles with matter, stopping power, range-energy relations, counting statistics, shielding, dosimetry, waste disposal, criticality prevention, radiation biology and ecology. Prereq: Consent of instructor.

490 Senior Seminar (1-3) Topic of current interest. May be repeated with consent of department. Maximum 6 hrs.

500 Thesis (1-15) P/NP only. E

501 Graduate Research Participation (3) Advanced research techniques under supervision of staff research director whose research area coincides with interests of student. Open to all graduate students in good standing. Prereq: Consent of department and research director. May be repeated with consent of department. Maximum 18 hrs. S/N/C only. E

502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when laboratory facilities are requested for research and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/N/C only. E

506 Experimental Methods (3) Principles, real operational behavior, and hazards of laser types, radiation detectors, photomultiplier tubes, image intensifiers, image converters, image diodes, streak cameras, and fast framing cameras; high-vacuum systems including cryogenic-based devices, data acquisition techniques including synchronous detection, digital electronics methods and micro-computer data acquisition and registration methods.

507 Contemporary Optics (3) Topics in geometrical, physical, Fourier, and nonlinear optics and introductory laser physics. Extensive use of computer calculations and design of practical and sophisticated optical systems.

508 Laser Physics (3) Mode analysis, stable and unstable resonators; rate equations and population inversion, saturation, relaxation oscillations, fluctuations and noise, laser stability; quantum theory of laser, photon coherence; mode-locking, Q-switching and frequency stabilization; specific laser types: semiconductor and solid-state, excimer, copper vapor and dye lasers.

511-12 Theoretical Physics (3,3) Classical theoretical physics with limited use of mathematics. Prereq: 512, 513, advanced calculus, differential equations, and vector analysis.


532 Advanced Classical Mechanics (3) Variational principles, canonical transformations, Hamilton-Jacobi theory, nonlinear mechanics, elasticity, fluid mechanics. Prereq: 531.


574 Group Theory for Physicists (3) Introduction to abstract group theory, discrete and continuous groups, representation theory, Noether's theorem, symmetries and conservation laws, application of group-theoretical methods to atomic physics, solid-state physics, and particle physics. Prereq: 571-72.

591 Foreign Study (1-15) See College of Arts and Sciences.

592 Off-Campus Study (1-15) See College of Arts and Sciences.

593 Independent Study (1-15) See College of Arts and Sciences.

594 Special Problems (3) Especially assigned theoretical or experimental work on problems not covered in other courses. May be repeated. Maximum 9 hrs. E


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


606 Nonlinear Optics (3) Nonlinear optical susceptibilities, wave propagation in nonlinear media, sum-frequency and difference frequency generation, harmonic generation, parametric amplification and oscillation, stimulated Raman processes, two- and multi-photon processes, four-wave mixing and phase conjugation, transient coherent optical effects and free induction decay, optical breakdown and nonlinear effects in plasmas.

610 Quantum Optics (3) Quantum theory of emission and absorption of radiation; frequency-dependent susceptibility; coherence theory; field quantization and coherent photon states; interaction of radiation with atoms, polaritons, coupling and higher-order coherence, atomic scattering phenomena. Prereq: 521.

611 Advanced Quantum Mechanics & Field Theory (3) Second quantization, quantization of electromagnetic field, emission, absorption, and scattering of light, bremsstrahlung, pair creation and annihilation, quantum field theory methods in condensed matter physics, and quantum optics. Topics vary according to interest of instructor. Prereq: 522 and 542 or equivalent. Prereq or coreq: 561 or consent of instructor.

612 Advanced Topics in Quantum Field Theory (3) Renormalization, Lamb shift, anomalous magnetic moments, gauge theories, electroweak theory, quantum chromodynamics, grand unified theories, and advanced topics in laser physics and quantum optics. Topics vary according to interest of students, instructor and present state of physics. Prereq: 561 or 611 or consent of instructor.

621-22 Nuclear Structure (3,3) General properties of nucleus; two-body scattering problems; saturation and saturation problems; cluster and quark models; nuclear density and nuclear radii; nuclear spectroscopy; special nuclear models; theory of nuclear reactions; theory of beta-decay. Prereq: 571-72.

626-27 Elementary Particle Physics (3,3) 626--Survey of elementary particle physics, experimental methods, conservation laws, invariance principles, and models of interactions. 627--Advanced topics: quark models, electroweak interactions and unification of elementary forces. Prereq: 522.

641 Advanced Topics in Classical Theory (3) To meet special needs of students. Advanced dynamics and