Aviation Systems

Aviation Systems (UT Space Institute)

MAJOR

DEGREE

Aviation Systems ........................................ M.S.

R. D. Kimberlin, Program Chair

Directors:

Collins, F. G., Ph.D. ....................... California
Frost, W., Ph.D. .............................. Washington
Mason, A. A., Ph.D. ......................... Tennessee
Roberts, R. M., Ph.D. ...................... AFIT
Wu, J. M., Ph.D. .............................. Cal Tech
Young, R. L., Ph.D. ......................... Northwestern

Associate Professors:

Kimberlin, R. D., M.S. ...................... Tennessee
Watts, C. F., M.S. ............................ Arizona

Assistant Professors:

Solies, U. P., Ph.D. ......................... Tennessee

The University of Tennessee Space Institute offers a program leading to the Master of Science degree with a major in Aviation Systems. The Aviation Systems program is designed for those who possess a Bachelor's degree in engineering or science and wish to study under a "system philosophy" toward careers in research and development or administration in areas pertinent to aviation. Current emphasis includes flight testing, aircraft design, aviation meteorology, air traffic control, and airport management.

To qualify for admission to this program, the applicant must possess a Bachelor's degree in engineering or science from an accredited institution, show evidence of ability to pursue and benefit from the program, and fulfill The University of Tennessee Graduate School admission procedures and grade-point standards. It is expected that the student will have a basic knowledge of computer utilization and statistics; an understanding of aerodynamic fundamentals, aircraft propulsion, and performance; and some understanding of economics.

Both thesis and non-thesis programs are available. The thesis program involves a minimum of 30 semester hours credit while the non-thesis program involves a minimum of 33 semester hours credit.

THESIS OPTION

The thesis program involves satisfactory completion of the following requirements:

Research and Development Specialization

1. Twelve hours of 500-level courses in the major field of aviation systems.
2. Six hours in industrial engineering (engineering management).
3. Twelve hours of electives in the major field, mathematics or engineering.
4. Twelve hours of electives in the major field, mathematics or engineering.
5. Six hours of Aviation Systems 500 demonstrating the ability to conduct and report on an independent investigation.

Non-Thesis Option

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

Research and Development Specialization

1. Twelve hours of 500-level courses in the major field of aviation systems.
2. Six hours in industrial engineering (engineering management).
3. Twelve hours of electives in the major field, mathematics or engineering.
4. Twelve hours of electives in the major field, mathematics or engineering.
5. Three hours of an assigned project under Aviation Systems 510.
6. A comprehensive final written examination on all coursework submitted for the degree and defense of the project course paper.

Administration Specialization

1. Twelve hours of 500-level courses in the major field of aviation systems.
2. Two hours in industrial engineering (engineering management).
3. Three hours in economics or finance.
4. Twelve hours of electives in the major field, mathematics or engineering.
5. Three hours of an assigned project under Aviation Systems 510.
6. A comprehensive final written examination on all coursework submitted for the degree and defense of the project course paper.

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 Aviation Systems is available to residents of the states of Arkansas, Kentucky, Mississippi, South Carolina, and West Virginia. Additional information may be obtained from the Residency Assistant in the Office of Graduate Admissions and Records.

GRADUATE COURSES

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

501 Aviation Systems: An Overview (3) Aviation systems, present and future. Socioeconomic base, aerospace and propulsion technology, meteorology, air traffic control, airport community interface, and technological trends and developments pertinent to present status and future development of air transportation. D

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 C only. E

503 Air Vehicles (3) Current capabilities and future requirements for civilian and military air vehicles. Parameters significant for air vehicle type selection. Integration of air vehicle into aviation systems. Prereq: 501.

505 Governmental Policies for Aviation (3) Theoretical and legal basis for economic and governmental regulation of aviation. Historical and legislative development of aviation regulatory agencies, organizational structure, administrative and enforcement procedures. Prereq: 501.

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

510 Special Topics in Aviation Systems (3) Current problems. Prereq: Consent of instructor. May be repeated with consent.


Biochemistry

(College of Liberal Arts)

MAJOR DEGREES

Biochemistry ........................................ M.S., Ph.D.

Wesley D. Wicks, Head

Professors:

Churchill, Jorge E., Ph.D. ............... Sheffield

Howell, Elizabeth E., Ph.D. ............... Michigan State

Monty, Kenneth J., Ph.D. ............... Rochester

Salo, T. P. (Emeritus), Ph.D. ............... Michigan

Wicks, Wesley D., Ph.D. ............... Harvard

Associate Professor:

Koontz, John W., Ph.D. ............... Kentucky

Assistant Professors:

Feinberg, R. H. (Emeritus), Ph.D. ............... California

Howell, Elizabeth E., Ph.D. ............... Lehigh

Roberts, Daniel M., Ph.D. ............... California (Davis)

Serpersu, Engin H., Ph.D. ............... Hakecepe

Adjunct Faculty:

Farkas, W., Ph.D. ............... Duke

Georghiu, S., Ph.D. ............... Manchester

Kannel, S., Ph.D. ............... California (San Diego)

THE MASTER'S PROGRAM

1. At least one year each of Introductory Organic Chemistry with laboratory and approved physical chemistry.
2. A minimum of 8 semester hours of approved courses taken beyond the introductory level and including the subject areas of genetics and physiology.
3. Biochemistry 511-12 and 515-16.
4. At least 6 hours of advanced seminar courses from the following: 601, 603, 604, 605, 606.
5. Six hours of Master's research and a thesis.
6. A final examination that covers both the thesis and the major subject matter of the course requirements.

THE DOCTORAL PROGRAM

1. Introductory Organic Chemistry, Introductory Physics, Differential and Integral Calculus, approved physical chemistry, and at least 12 hours of biology beyond the introductory level and including the subjects of genetics and physiology.
2. Biochemistry 511-12 and 515-16.
3. At least 3 hours of approved graduate courses in chemistry, physics, or other physical science; for example, Chemistry 550, 551, 552, Physics 521, 522, 523. No survey courses will be accepted.
4. At least 6 hours of topics offered in 521 and 621.
5. Participation in 601 and 603 during the entire period of residence.
6. Comprehensive examination, taken before the end of the third year of study.
7. A dissertation reporting the results of original research and significant research carried out during the term of candidacy.
8. A final oral examination which will be concerned primarily with the student's dissertation.

"Though completion of these courses or their equivalent is required, they may not be taken for graduate credit.

Petitioning for Master's Degree

Students who have passed the comprehensive examination in the Ph.D. program and have completed at least 30 hours of approved coursework for graduate credit, at least two-thirds of which must be at or above the 500 level, may petition the department for award of a Master's degree. The additional requirements for such a degree are:

1. The preparation of a research manuscript suitable for submission for publication in a major scientific journal and oral defense of that manuscript before an examining committee of three faculty members appointed by the head of the department, at least two of whom shall be members of the department; or
2. Publication of at least one full-length paper in a major biochemical journal as senior author.

GRADUATE COURSES

410 Cellular and Comparative Biochemistry (4) Electrophoretic behavior; chemistry and structure of proteins; enzyme behavior and biological function; catalysis and energy capture; synthetic metabolism; nucleic acid function; protein synthesis, and biochemical genetics; regulation of biological processes. Prereq: Chemistry 350-60-69 and Biology 110-20. 3 hrs and 1 discussion. F,Sp


471-81 Biophysical Chemistry (3,3) Physical principles in applications to biological systems. 471-Thermodynamics; chemical equilibrium; solution chemistry; protein; enzyme; kinetic; enzyme-catalyzed reactions. 481-Elementary quantum chemistry; interactions of light with biological molecules; optical and magnetic spectroscopy; light scattering; case studies of selected macromolecules. Prereq: Calculus, Organic Chemistry, General Biology or consent of instructor. (Same as Chemistry 471-81.) 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. Prior degree is completed. May not be used toward degree requirements. May be repeated. S/N only. E

511 Advanced Concepts in Protein Structure, Protein Function and Intermediary Metabolism (4) Protein structure and function; intermediary metabolism; membrane structure and function. Original literature and review articles; contemporary experimental research; indispensable to graduate research. Prereq: 410, 420 or consent of instructor. 3 hrs and 1 discussion. F

512 Advanced Molecular Biology (4) Replication, repair, transcription, translation and control mechanisms. Prior knowledge in basic science fundamentals of gene expression. Prereq: 511 or Life Sciences 511 lectures and discussion. (Same as Life Sciences 512.) Sp

515 Experimental Techniques I (3) Modern experimental methodology and instrumentation in biochemistry. Primarily for departmental graduate students. Prereq: Consent of instructor.

516 Experimental Techniques II (3) Laboratory rotations. Student works in laboratory of faculty member on clearly defined project. Written proposal and oral report. Primarily for departmental graduate students. Prereq: 515. Sp

521 Special Topics (1-3) Registration only by prior arrangement with department. May be repeated. Maximum 9 hrs.

525 Graduate Research Participation (3-12) Tutorial laboratory experience. May be repeated. Maximum 12 hrs. E

561 Environmental Toxicology (3) Basic concepts in toxicology; molecular toxicity and detoxification; reductive toxicology; mutagenesis, teratogenesis, carcinogenesis, pathologic changes and environmental impact. Prereq: 410, Chemistry 350-60-69 or consent of instructor. (Same as Ecology 561.) F

562 Techniques in Environmental Toxicology (1) Experimental techniques for assessment of presence, toxicity, and impact of pollutants in global ecosystem. Laboratory exercises on analytical, biochemical, and bioassay methods in toxicological studies. Prereq: 419 (or quantitative analysis) 561 and Chemistry 350-60-69. (Same as Ecology 562.) Sp

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

601 Advanced Biochemistry Seminar (1) Invited speakers. Topics in biochemistry; advance in research. Required every semester in residence. S/N only. F,Sp

603 Current Topics in Biochemistry (1) Seminars and lectures dealing with current advances in field of chemical biochemistry. Required every semester in residence. S/N only. F,Sp

604 Current Topics in Environmental Toxicology (1) Critical reviews of research problems and methods in environmental toxicology, behavioral toxicology, biochemical and ecologic effects, biostatistics and epidemiology. Presentations by students, faculty and guest lecturers from academia and industry. Can be repeated with consent of department. Maximum 4 hrs. (Same as Ecology 604.) S/N only. F,Sp

605 Current Topics in Regulation of Protein Function (1) Concepts and organization of proteins by phosphorylation-dephosphorylation allosteric interac-
606 Current Topics in Biological Membrane Re-
teaching (1) Prereq: 410 or equivalent. May be repeated.
Maximum 9 hrs. (Same as Microbiology 606.) S/N only. F.Sp
621 Advanced Topics (1-3) Biochemical and bioph-
ysical methods, mechanisms of enzyme catalysis,
gene expression, membrane structure and function,
metabolic regulation, physical biochemistry. Prereq:
511-12 or consent of instructor. May be repeated. Maxi-
mum 9 hrs.

Biomedical
Sciences

(Office of the Provost)

MAJOR              DEGREES
Biomedical Sciences   M.S., Ph.D.
Raymond A. Popp, Director
Professor:
Olins, Donald E., Ph.D. Rockefeller
Research Professor:
Olins, Ada L., Ph.D. New York
Uberbacher, Edward C., Ph.D. Pennsylvania
Research Associate Professor:
Ch'ang, Lan-Yang, Ph.D. Vanderbilt
Research Assistant Professor:
Foote, Robert S., Ph.D. Duke
Shared Faculty:
Not all faculty listed are necessarily available in teaching and/or research roles in every academic year.

Burick, Gerald J., Ph.D. Pennsylvania
Cook, John S., Ph.D. Princeton
Fry, R. J., M.D. Dublin
Fujimura, Robert K., Ph.D. Wisconsin
Gehrs, C. W., Ph.D. Oklahoma
Hartman, Fred C., Ph.D. Tennessee
Jacobson, K. Bruce, Ph.D. Johns Hopkins
Kenna, Steve, Ph.D. California (San Diego)
Kenney, Francis T., Ph.D. Johns Hopkins
Larimer, Frank W., Ph.D. Florida State
Lee, Kai-Lin, Ph.D. Tulane
Littlefield, Gayle, Ph.D. Georgia
Marchok, Ann C., Ph.D. Connecticut
Mazur, Peter, Ph.D. Harvard
Mitra, Sankar, Ph.D. Wisconsin
Mural, Richard, Ph.D. Georgia
Niyogi, Salli K., Ph.D. Northwestern
Pop, Raymond A., Ph.D. Michigan
Preston, R. Julian, Ph.D. Reading
Regan, James D., Ph.D. F.Sp
Richmond, G. R., Ph.D. New Mexico
Rinchik, Eugene M., Ph.D. Duke
Russell, Liane B., Ph.D. Chicago
Sega, G. A., Ph.D. Louisiana State
Shugart, Lee H., Ph.D. Tennessee
Snyder, Fred L., Ph.D. North Dakota
Solomon, A., M.D. Duke
Stevens, Audrey L., Ph.D. Western Reserve
Terzaghi-Howe, Peggy, D.Sc. Harvard
Vo-Dinh, Tuan, Ph.D. Swiss Fed IT
Waters, Larry C., Ph.D. Georgia
Woychik, Richard P., Ph.D. Case Western
Yang, Wen K., M.D., Ph.D. Tulane

The University of Tennessee-Oak Ridge Graduate School of Biomedical Sciences, located within the Biology Division of Oak Ridge National Laboratory, offers programs leading to the Master of Science and the Doctor of Philosopy. The National Laboratory is a well-known center of basic research. The school utilizes the staff and facilities of this laboratory and thus brings directly into the mainstream of full-time graduate education, a high faculty-to-student ratio, is based on intensive graduate courses supplemented by tutorial instruction, participation in a wide variety of seminars, and a heavy emphasis on communication skills, research training, and independent study. The program encourages students to pursue graduate studies to the limits of their abilities.

Each student's curriculum is planned to meet individual needs, with the aim of giving: (1) strength in the basic sciences; (2) perception of the biomedical sciences as a whole; and (3) experience and training in a chosen specialty.

The concentration areas available for Master's thesis and Ph.D. dissertation work are: biochemistry, biophysics, carcinogenesis, genetics, cellular, developmental and mammalian biology, and radiation biology. Included are such subjects as immunology, protein and enzyme chemistry, the life sciences, cytology, radiation and environmental biology, virology, developmental biology, experimental pathology, microbial and mammalian genetics, nutrigenetics, and problems of aging.

ADMISSION REQUIREMENTS

A Bachelor's degree or its equivalent is required. Students with M.S., D.V.M., or M.D. degrees are also encouraged to apply. Completed applications, Graduate Record Examination scores and letters of reference should be sent to the address below. The student will need preparation in biology, calculus, physics, and organic and physical chemistry. A course in physical chemistry is offered by the school in order to meet the last requirement. It is recommended that deficiencies in preparation, as identified in the admission process, be eliminated prior to entrance.

Requests for application forms, information on admission, financial support, and housing should be sent to Director, University of Tennessee-Oak Ridge Graduate School of Biomedical Sciences, Biology Division, ORNL, Box 2008, Oak Ridge, Tennessee 37831-8077.

THE DOCTORAL PROGRAM

1. Satisfactory (B grade or better) completion of the following core courses or their equivalent: Biochemistry (511); Biophysical Biochemistry (514); Cell Biology (518-19); plus any three of the following courses: Genetics (515); Molecular Genetics (517); Statistics for Biologists (514); or Computing for the Life Sciences (525); and Statistics for Biologists (574).

2. Three semesters of Biomedical Sciences Laboratory (531-33-33).

3. Participation in at least one of the seminars during each term of residence after the first year strongly recommended, e.g., Satisfactory completion of formal advanced courses in the areas of the student's interests. The number and nature of the required advanced courses will vary depending upon the student's background and area of specialization.

4. Passing both written and oral comprehensive examinations.

5. A dissertation reporting the results of original and significant scientific research. A minimum of 24 semester hours of course 600 is required.

6. A formal seminar presentation of the dissertation research.

SPECIAL MASTER OF SCIENCE DEGREE PROGRAM

The graduate faculty has designed a Master of Science program in Biomedical Sciences primarily to fill the need for such a degree within the Oak Ridge National Laboratories; however, a limited number of students from other institutions may be accepted if qualified and as space is available. The requirements for the degree are:

1. Graduate credit or a proficiency in the following core courses: Biochemistry (511); Biophysical Biochemistry (514); Cell Biology (518-19); plus any three of the following courses: Genetics (515); Molecular Genetics (517); Statistics for Biologists (514); or Computing for the Life Sciences (525). Additional credits may be obtained (6 to 15 hours) with electives.

2. Thirty hours of approved graduate courses including 6 hours for thesis.

3. For admission to candidacy: Completion of any required prerequisite courses and one semester of graduate coursework with a B average. Admission to candidacy forms must be filed at least one full semester prior to receipt of degree.

4. A Master's committee of three approved faculty members upon admission to candidacy.

5. A thesis reporting results of original and significant scientific research.

6. Passing a final oral examination.

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

507 Physical Chemistry (3) Thermodynamics; phase equilibria; chemical equilibria; electro motive force; surface chemistry; electrolyte solutions; kinetics; conductance; viscosity; diffusion.


514 Biophysical Biochemistry (3) Chemistry metabolism and biosynthesis of purines, pyrimidines and nucleic acids; biosynthesis of RNA, DNA, and proteins. Energy levels and excited states of large molecules (515); optical instrumentation; adaptations to system perturbations; properties of macromolecules in solution; mo-


Botany

(College of Liberal Arts)

MAJOR

Botany ................................................. M.S., Ph.D.

Karen W. Hughes, Head

Professors:

Caponetti, J. D., Ph.D. ............... Harvard
Otebsch, E. C., Ph.D. ... Duke
DeSelms, H. R. (Emeritus), Ph.D. .... Ohio State
Evans, A. M., Ph.D. ................... Michigan
Hemond, W. R. (Distinguished Prof.), Ph.D. .......... Vanderbilt
Hickok, L. G., Ph.D. .... Massachusetts
Holton, R. W., Ph.D. ................. Michigan
Hughes, K. W., Ph.D. ............... Utah
Jones, L. W., Ph.D. ............... Texas
McCormick, J. F., Ph.D. ............. Emory
Mullin, B., Ph.D. ............... NC State
Norris, F. H. (Emeritus), Ph.D. ........... Ohio State
Petersen, R. H. (Distinguished Prof.), Ph.D. .......... Columbia
Sharp, A. J. (Emeritus), (Distinguished Prof.), Ph.D. .... Ohio State
Smith, W. O., Ph.D. ............... Duke
Waltz, P. (Distinguished Prof.), Ph.D. .......... Texas

Associate Professors:

Amundsen, C. C., Ph.D. ........... Colorado
Heiman, A. S., Ph.D. ............... Ohio State
Schilling, E. E., Ph.D. ............... Indiana
Schwarz, O. J., Ph.D. ............... NC State
Smith, D. K., Ph.D. ............... Tennessee
Wofford, B. E. (Curator), Ph.D. ........ Tennessee

Lecturer:

McFarland, K., Ph.D. ............... Tennessee

The Department of Botany offers the Master of Science and Doctor of Philosophy degrees with concentrations in anatomy, botany, cytology, genetics, ecology, genetics, ichenology, morphology, mycology, phytobiology, physiology, phytology, pteridology, and taxonomy.

Educational service is required of each graduate degree candidate and such service will include teaching and/or ancillary services performed in the department related to the instruction of courses.

For further information, contact the Department Head or the Graduate Coordinator.

ADMISSION REQUIREMENTS

The Botany Department requires scores from the general and subject biology portions of the Graduate Record Examination, at least three letters of recommendation or standard recommendation forms from academic or professional persons, a short statement describing reasons for interest in graduate education in botany, and the following academic requirements:

1. Bachelor's degree: a B.A. or B.S. from an accredited college or university with a cumulative grade-point average of 2.5 or better (on a 4.0 scale), with evidence of ability to do work of graduate quality.
2. General botany or general biology: 8 semester hours.
3. Advanced botany or closely allied biological sciences: 12 semester hours.
4. Physical sciences: general inorganic chemistry: 8 semester hours; organic chemistry; physics highly recommended.
5. College mathematics: 6 semester hours including 1 term of calculus.

Evidence of a broad undergraduate background, an ability to do work of graduate quality, and an interest in the study of plant sciences are considered to be much more important than the particular courses taken as an undergraduate. Accordingly, students lacking specific prerequisite courses but otherwise qualified may be admitted to graduate studies in botany. In such cases, the deficiencies should be removed as soon as possible, typically during the first year of the student's graduate program. The determination of deficiencies and the manner in which they will be removed will be decided upon by the student's pro-temp committee during the first meeting with the student.

THE MASTER'S PROGRAM

The program for the Master of Science is patterned to fit the needs of students who desire a less extensive course of study than the Ph.D. program. However, they must be equally well prepared and display an aptitude and ability for advanced study. The M.S. includes thesis and non-thesis options.

Thesis Option

The thesis program is the normal route taken by botany students for the M.S. In accordance with the emphasis of the University and the department on research, it involves writing and defending a thesis to describe the results of a completed research project of

lucular solution; molecular conformations; inter- and intramolecular forces; principles of microscopy. Prereq: 511.
515 Genetics (3) Mendelian genetics, mitosis and meiosis; transmission genetics; mapping and linkage; genetics of shape, bacteria and eucaryotes, mapping, linkage recombination; mechanisms of recombination, chromosome structure and replication.
517 Molecular Genetics (2) Molecular biology of prokaryotes. DNA replication, transcription, translation, genetic recombination, nucleic acids, and their potential role in induction of cancers.
641 Techniques in Cell Biology (3) Basic concepts of cell biology techniques, their application to specific research problems, kind of data yield, and cautions in data interpretation. Laboratory demonstrations may be arranged where appropriate. Prereq: 515, 514, 519, 519.
651-523 Advanced Topics in Biomedical Sciences (3,3,3) Current and future research developments: protein synthesis, protein chemistry and enzyme mechanisms; cytology, and special topics. Either as tutorial or literature survey requiring substantial student preparation. May be repeated.
660 mammalian Genetics (3) known genetic variants affecting each organ system of experimental mammals, especially laboratory mice. Inheritance of phenotypical and biochemical traits in rodents and other laboratory rodents. Prereq: 515.
665 Microbial Genetics (3) Basic phenomena in microbial genetics: transcription, transmission, conjugation, and mutation. Genetics of bacteriophage. Prereq: 515.
666 Cytogenetics (3) Chromosome structure, chromosome alterations (mitosis and meiosis), mechanisms of induction of chromosomal alterations by radiation and chemicals, the role of chromosomal instability and its role in hybridization. Changes in chromosomes and human cytogenetics, sister chromatid exchanges, human genetic risk assessment, molecular techniques for analyzing chromosome changes. Prereq: 515.
531-32-33 Biomedical Sciences Laboratory (3,3,3) Approaches and technologies in various areas of modern biology. Students spend a semester in each of three laboratories conducting research in different areas of biomedical science. Required of all first-year students. Prereq: 514-46-49.
551-53 Special Topics in Biomedical Sciences (3,3,3) Either tutorials or formal lectures. Potential topics: X-ray diffraction and crystallography; excited-state biochemistry; biophysical chemistry or macromolecules; pathology; mammalian genetics coverage.
574 Statistics for Biologists (2) Application and interpretation of statistical methods in data analysis. Random variables, normal, binomial, and Poisson distribution, statistical inference, testing hypotheses, means and variances; confidence intervals; tests of significance for comparing samples; analysis of variance; contingency tables; Chi-square tests; correlation and association; linear regression. Prereq: Statistics 201 or consent of instructor.
600 Doctoral Research and Dissertation (3-15) P/NP only. E
622 Enzyme Regulation and Kinetics (3) Kinetics of catalysis, inhibition by product, substance and dead end inhibitors; stimulation and inhibition of allosteric enzymes, types of feedback regulation; role of sub-units in enzyme regulatory systems. Prereq: 515, 517, 519.
624 Chemistry and Metabolism of Lipids (2) Nomenclature, chromatographic isolation, chemistry, physical properties, and enzymology and lipids. Hormonal action of prostaglandins and role of lipids in membranes, enzymic expression, and nervous tissue. Lipid biochemistry of mammals. Comparative aspects, lipid pathways in bacteria and yeast. Prereq: 514.
628 Molecular Genetics of Carcinogenesis (2) DNA and RNA virus tumors, oncogenes, growth factors, and their potential role in induction of cancers.

The Botany Department requires scores from the general and subject biology portions of the Graduate Record Examination, at least three letters of recommendation or standard recommendation forms from academic or professional persons, a short statement describing reasons for interest in graduate education in botany, and the following academic requirements:

1. Bachelor's degree: a B.A. or B.S. from an accredited college or university with a cumulative grade-point average of 2.5 or better (on a 4.0 scale), with evidence of ability to do work of graduate quality.
2. General botany or general biology: 8 semester hours.
3. Advanced botany or closely allied biological sciences: 12 semester hours.
4. Physical sciences: general inorganic chemistry: 8 semester hours; organic chemistry; physics highly recommended.
5. College mathematics: 6 semester hours including 1 term of calculus.

Evidence of a broad undergraduate background, an ability to do work of graduate quality, and an interest in the study of plant sciences are considered to be much more important than the particular courses taken as an undergraduate. Accordingly, students lacking specific prerequisite courses but otherwise qualified may be admitted to graduate studies in botany. In such cases, the deficiencies should be removed as soon as possible, typically during the first year of the student's graduate program. The determination of deficiencies and the manner in which they will be removed will be decided upon by the student's pro-temp committee during the first meeting with the student.

THE MASTER'S PROGRAM

The program for the Master of Science is patterned to fit the needs of students who desire a less extensive course of study than the Ph.D. program. However, they must be equally well prepared and display an aptitude and ability for advanced study. The M.S. includes thesis and non-thesis options.

Thesis Option

The thesis program is the normal route taken by botany students for the M.S. In accordance with the emphasis of the University and the department on research, it involves writing and defending a thesis to describe the results of a completed research project of
original work. It is important that the entering student promptly identify a major professor and a suitable research project. (It may be either a terminal degree or a preliminary step to studying for a Ph.D. degree).

2. Satisfactory preparation of a written formulation and an oral defense to the student’s committee of a research proposal suitable for a thesis. This must be completed before enrollment in Botany 500.

3. Successful completion of 30 hours of graduate credit, at least two-thirds of which must be at the 500 level or higher.

4. Satisfactory completion of two hours at the 600 level.

5. Educational service in the form of teaching and/or ancillary services; consult major professor and department head.

**Non-Thesis Option**

Satisfactory completion of 34 semester hours of approved graduate courses of which 30 semester hours must be in botany including Botany 503. At least two-thirds of the hours must be at the 500 level or higher.

1. Satisfactory completion of two hours at the 600 level.

2. Educational service in the form of teaching and/or ancillary services; consult major professor and department head.

3. Satisfactory performance on a final written examination on all work offered for the degree. The student’s committee may also require that an oral examination follow the written examination.

**THE DOCTORAL PROGRAM**

The Doctor of Philosophy program is patterned on the graduate training that involves independent research within the student’s area of concentration. Although there is no formal program of coursework, the student’s committee may require specific courses for the completion of the degree. Most students spend from three to five years working on their Ph.D.

Requirements for successful completion of the Ph.D. are as follows:

1. Satisfactory presentation of a research problem by means of a written proposal and an oral defense to the student’s committee. This must be completed before enrollment in Botany 600.

2. Satisfactory performance on a written comprehensive examination.

3. Presentation of one or more cognate areas outside of the department totaling 6 hours of graduate credit with at least a B average.

4. Satisfactory performance on an examination in one modern foreign language (see Graduate Coordinator) or an A or B in French 302 or German 332.

5. Satisfactory completion of 6 hours at the 600 level (excluding dissertation).


7. Presentation of a department seminar near the end of the doctoral program.

Note: The listed requirements for the M.S. and Ph.D. degrees should be interpreted as minimal requirements. Specific stipulations or requirements such as additional foreign languages or an additional oral comprehensive examination may be required by the student’s faculty committee.

**GRADUATE COURSES**

401-02 Field Studies in Botany (3,3) Field experience and taxonomy of special plant groups. Topics vary: botany, lichenology, pteridology, agroecology, mycology, phycology, aquatic vascular plants, sylvantherology, woody plants, and botanical photography. May be repeated under different topic. Maximum 9 hrs.


412 Plant Anatomy (3) Cells, tissues and organs; development in vegetative and reproductive structures of vascular plants—seed plants. Prereq: 110-20 or Biology 110-20.

426 Paleobotany and Palynology (3) (Same as Geology 426.)

431 Plant Ecology (3) Interactions between individuals, species, communities, and their environments. Circula- tion of energy and matter in ecosystems. Weekly field trips or laboratory periods, and at least two weekend field trips. Prereq: 330 or equivalent. Su

451 Plant Tissue Culture (3) Methods for culture of cells, tissues, and organ culture, media preparation and main- tenance of cultures. Prereq: 110-20 or Biology 110-20 or equivalent and Chemistry 120-32 or equivalent. Recom- mended prereq: 215-20, 401-02, 435-40. Microbiology 310 or 319; Ornamental Horticulture and Landscape Design 330; and Plant and Soil Science 331.

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

501 Mycology (4) Intensive survey of fungi, all major classes, lecture laboratory and field information. Occa- sional field trips. Prereq: 310. 3 hrs and 1 lab. Su,A

502 Registration for Use of Facilities (3-15) Required for the student not otherwise registered during any semester when university facility 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 Non-Thesis Research (2) Library, field, or labora- tory research under supervision of staff member. Not for thesis candidates. May be repeated. Maximum 4 hrs. E

506 Phycology (4) Comparative study of major algal phyla, both freshwater and marine; morphological, de- velopmental, ecological, taxonomic and phylogenetic aspects. Field and laboratory studies, identification, classification, experimentation. Prereq: 310 or consent of instructor. 3 hrs and 1 lab. F,A

507 Biological illustration (3) Principles and ap- plications of photography (B/W and Color) photomacro- and photomicrography, drawing, graphics and video for recording and dissemination for research and publication of data in pictorial and graphic form.

509 Morphology and Evolution of Basidiomycetes (4) Structure and function of somatic and sexual life cycles as applied to evolution in group. Cycles and specimens in laboratory. Prereq: 310 or equivalent.

512 Taxonomy of Grasses and Grass-like Plants (3) Collection, identification, classification of grasses, sedges and rushes, phylogeny of the grass subfamily and tribes; prereq: 330 or consent of instructor. F, A


521-22 Advanced Plant Physiology I, II (3,3) 521- Plant biochemistry and metabolism: respiration, photosynthesis, carbon processing, and biosynthesis of spe- cialized plant products (e.g., enzymes, cell wall polymers, and plant growth regulators). 522--Growth and differen- tiation of plants at molecular, cellular and organismic levels. Hormonal regulation of development; macromolecular interpretation of differentiation, dormancy, germi- nation, flowering and senescence. Prereq: Introduction to Biochemistry or consent of instructor or Introductory Plant Physiology or Cell Biology.

530 Advanced Taxonomy of Flowering Plants (3) Evolution and classification of families of angiosperms, local flora. Prereq: 330 or equivalent. 2 hrs and 1 lab. F,A

531-32 Special Problems in Botany (1-4) May be repeated. Maximum 12 hrs.

536 Plant Communities and Plant Geography (4) Plants in communities and their classification and ordina- tion; geographic distribution data; plant biogeography, cli- matic and soils relationships. Prereq: 431. (Same as Geography 536.)

537 Natural Resource Management and Environ- mental Assessment in North America's National Parks (3) (Same as Ecology 537 and Planning 553.)

544 Seminar in Botany (1) Readings and discussions of current literature and/or selected topics in botanical research. May be repeated. Maximum 5 hrs. S/NC only.


555 Seminar in Quaternary Studies (3) (Same as Geology 555 and Zoology 555.)

556 Phytoplankton Ecology (3) Interaction between environment and phytoplankton. Nutrient uptake, pri- mary production, competition, ecological theory applied to phytoplankton communities, and physiological adap- tation of populations to environment. Prereq: 310 or consent of instructor.

573 Population Biology (3) (Same as Ecology and Zoology 573.)

578 Plant Cell Biology (4) Plant cellular organization, structure and function, interaction of cellular compo- nents and correlation of their structures and functions. Principles and application of analytical and experimental laboratory procedures in cell biology research. Prereq: 520 or equivalent. Recommended prereq: Biochemistry 410-10. 3 hrs and 1 lab. F,A

590 Bryophytes and Pteridophytes (4) Taxonomy, phycology, ecology and developmental morphology; field study and current research. Prereq: 310 or 20 hrs and 2 labs. F,A

591 Cytogenetics (3) Chromosome structure and behavior during mitotic and meiotic divisions in relation to structural changes, genetic controls, hybridization, speci- fication, and polyploidy. Laboratory emphasis on normal and aberrant meiotic systems and somatic chromo- somes from plants and animals. Prereq. 310 and at least 6 additional hrs in biological sciences, (Same as Forestry 581.) Sp,A

592 Methods and Instrumentation in Laboratory Investigation (1) Practical experience and theoretical background in various research methods, ion exchange resins, adsorption spectrometry, disk electrophoresis, photoelectrometry, x-ray, field studies and current research. Prereq: 310 and at least 6 additional hrs in biological sciences, (Same as Forestry 581.) Sp,A

593 The Field Research Problem (3) Conceptualiza- tion, planning, and implementing field research. Crite- ria for choosing instruments, sampling methods, data gathering, locations for study of populations, communities, and ecosystem. Field practice. Development and critique of formal research proposal like those required by granting and contracting agencies. Prereq: 431 or 535 or 573.

595 Methods and Instrumentation in Field Investi- gation (1) Appropriate methods and instrumentation. Topics vary. May be repeated with consent of instructor. Maximum 5 hrs. S/NC only.

596 Developmental Plant Morphology (3) Develop- mental morphology of plants from vegetative and reproductive organogenesis, and of organ determination and differentiation. Prereq: 510, 520 or 412 and 521 or 521 or consent of instructor. 2 hrs and 1 lab. F,A

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

606-07 Advanced Topics in Botanical Sciences (1-3, 1-3) Experimental and theoretical scientific investigations. Prereq: 431 or 432 or 410 or 412 or consent of instructor. 2 hrs and 1 lab. F,A

650 Research on the University of Illinois campus, supervised by a faculty member. The student must be registered for the semester throughout the period of study. This cannot be repeated.

653 Botany 55
632 Ecosystems of the World (2) Characterization of world and regional ecosystems; special characteristics of ecosystem function. F.A.

637 Applied Ecology (3) Same as Ecology 637.

662 Seminar in the History of Botany (2) History of botanical exploration and advances from early civilization to modern periods. May be repeated. Maximum 4 hrs.

Broadcasting

(College of Communications)

MAJOR

DEGREES

Communications ........................................ M.S., Ph.D.

Norman R. Swan, Head

Professors:

Holt, Darrel W. (Emeritus), Ph.D. .................................... Northwestern

Howard, Herbert H., Ph.D. ......................................... Ohio

Swan, Norman R., Ph.D. ........................................ Missouri

Associate Professor:

Moore, B. A., Ph.D. ............................................ Ohio

Assistant Professors:

Buchman, Joseph, Ph.D. ......................................... Indiana

Manning-Miller, Carmen, Ph.D. ................................ Indiana

Ziegler, Dhyana, Ph.D. .......................................... Southern Illinois

Adjunct Professor:

Nelson, Lindsay, B. A. .......................................... Tennessee

The Department of Broadcasting 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

410 Television News (3) Writing, reporting, performing, and producing news for television. Experience as reporter/producer for television news program. Electronic news gathering equipment and techniques, video editing. Prereq: 310. 1 hrs and 4 labs. E

420 Radio-TV Sales and Promotion (3) Problems and practices of television, radio, and cable sales and promotion. Case studies in sales, sales management, pricing, rate cards, use of rating, and sales presentation. Effective station promotion techniques. Prereq: 320. F

430 Producing for Television (3) Principles of television studio and field production, both technical and creative. Writing, producing, shooting, and editing video stories and programs. 3/4" cameras, recorders, and editing system. Prereq: 330. E


490 Radio & Television Management (3) Business policies and practices of broadcast operations, departmental function, cost and income analysis, leadership styles and techniques, mid-level management. Capstone course to be taken in student's last semester. Prereq: 275, 310, 320, 330. E

560 Radio & Television Law and Regulations (3) Legal problems faced by broadcast managers. Philosophies of regulatory policy formation. Efforts at self-regulation. Sociopolitical restraints, effects of laws and regulations, and public pressure on stations, networks, cable, and new technologies. Unique situation of broadcasting among media in terms of regulations. Prereq: Consent of instructor or admission to program. F

570 Radio & Television Research (3) Various techniques used by stations and consultants in broadcast research. Applied audience research. Deciding which method to use, interpreting results, and applying research to management decision making. Prereq: Communications 512 or 612, or consent of instructor. Sp

580 Seminar in Radio & Television (3) Salient issues in broadcasting. Topics vary. International broadcasting, cable television, new technologies, corporate television, educational and public broadcasting, broadcasting and society. Prereq: Consent of instructor or admission to program.

590 Advanced Radio & Television Management (3) Financial management of broadcast operations: budgeting, financial planning, accounting, and related techniques. Theoretical perspectives in broadcast management, organization and management of commercial and non-commercial operations from perspective of general manager. Prereq: 490. Sp

597 Independent Study (3) Prereq: Consent of instructor. May be repeated. Maximum 6 hrs. E

598 Internship (3) Full-time (30-40 hrs per week) work experience in news, production, or sales and management with non-university professional organization. Educational experience beyond that available at university. Final term paper. No retroactive credit for previous work experience. Prereq: Senior or graduate standing, completion of at least 11 hrs of broadcasting courses, GPA 3.0 or better, and consent of department head.

Business Administration

(College of Business Administration)

MAJOR

DEGREES

Business Administration .......................... MBA, J.D.-MBA, Ph.D.

The College of Business Administration offers two college-wide programs, the MBA and the Ph.D. with a major in Business Administration. A dual degree program is available with the College of Law leading to the J.D.-M.B.A.

To obtain application materials, write or call: Associate Dean for Graduate Business Programs, Suite 527, Stokely Management Center, College of Business Administration, The University of Tennessee, Knoxville, TN 37996-0550, Telephone: (615) 974-5033.

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 basis. The Ph.D. in Business Administration is available to residents of Virginia; the MBA is available to residents of Arkansas, Louisiana, or Virginia; and the Ph.D. and MBA concentration in logistics and transportation is available to residents of West Virginia.

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.

THE MBA PROGRAM

The MBA program is designed for students with undergraduate degrees in the social and natural sciences, the humanities, and professional fields such as engineering, business, agriculture, and architecture. For full-time students, the MBA program is a two-year, lock-step program with students beginning in the fall of each year and graduating in the spring, two years hence. During the summer between the first and second year, students must complete an internship with a company using those skills acquired during the first year of the MBA program.

The complete MBA program with a concentration in management or new venture analysis and entrepreneurship is offered for part-time evening students. The part-time program has the same admissions requirements, curriculum, and faculty as the full-time program. Part-time students are required to successfully complete six hours of graduate credit per semester.

The program consists of 14 MBA core courses and 5 concentration/elective courses. Each course is 3 semester hours of graduate credit with the exceptions of Business Administration 501 and 503, which are one semester hour of graduate credit each.

Admission Requirements

Applications are accepted for fall semester only. The application deadlines for fall semester are March 1 for international students and April 1 for others. Applications by U.S. citizens and permanent residents received after April 1 will be considered as space allows.

To be considered for admission, the applicant's file must include: A completed file includes the Graduate School Application, transcripts of prior college work, the MBA program application, two completed applicant recommendation forms, and the Graduate Management Admission Test (GMAT) score report. The first items should reach The Graduate School ten days before the MBA application deadline to allow for processing. Additional information is required by The Graduate School for international students.

For admission to the MBA program, consideration is given to (1) applicant's academic record with particular attention to the last two years of undergraduate work and previous graduate studies, (2) scores on the GMAT and the Test of English as a Foreign Language (TOEFL) for those whose native language is not English, (3) work experience and other activities that demonstrate potential for leadership, and (4) recommendations from professors and work supervisors. The admission decision is based on all factors which make up the total application; therefore, there is no automatic cut-off for either grade point averages or GMAT scores.
MBA Core

The following courses are required in each student's program. For full-time students, the sequence of core courses is:

Third semester: Economics 501, Business Administration 504.

The same courses, but in a different sequence, comprise the core for part-time students.

Concentration and Electives

A concentration area may be indicated on the MBA Program Application or this declaration may be deferred until after matriculation. In any event, selection must be made no later than the fall semester of entry into the program. Students whose undergraduate training does not include calculus must be in one of the following concentration areas: Accounting, Economics, or Mathematics.

Concentration areas must have completed two years of college-level calculus.

Other Requirements

The following courses are required in each student's program, a B average or higher in courses comprising the concentration area, and a B average or higher in the overall program. The student must demonstrate competency in these areas in a comprehensive exam administered in the capstone course, Business Administration 509.

BUSINESS ADMINISTRATION CONCENTRATION

For complete listing of MBA program requirements, see above.

MBA Concentration: New Venture Analysis and Entrepreneurship.

The concentration is comprised of three specific courses that are interdisciplinary in nature. This concentration strives to build a strong academic foundation for both entrepreneurial and intrapreneurial activities.

The new venture analysis and entrepreneurship concentration is offered to both the full- and part-time student in recognition of the growing trend in American business today towards new product/venture development. The new venture analysis/entrepreneurship concentration courses may be combined with two elective courses in another area (management or marketing) to achieve a dual concentration.

Minimum course requirements are Finance 551, Management 551, and Marketing 550. These course descriptions are listed under their fields of instruction.

PRE-MBA PROGRAM

The College offers a joint BA/MBA program with the College of Liberal Arts. Students in this program take their first three years of coursework in Liberal Arts, and their last two years in the College of Business Administration. Within their first three years, students fulfill all general education requirements for the BA degree, both upper and lower division along with a minor offered by one of the Liberal Arts departments. They may use one Economics course only to fulfill distribution requirements, and they are required to take a year of calculus as the only prerequisite to the MBA.

Admission requirements are higher than those normally expected of MBA applicants.

Desired qualifications include a minimum 3.4 GPA and a GMAT score of 600 or higher.

Students interested in the program are counseled initially in the Liberal Arts Advising Center regarding the appropriate Liberal Arts requirements. At the end of their second year, they have a conference with the Associate Dean for Graduate Business Programs and are advised of their prospects for formal admission. Students who are unlikely candidates are advised to take the Graduate Management Admission Test in October of the third year, and to submit an application to the MBA program. The admission decision is made by January of the third year.

Upon admission, students begin MBA coursework in the fourth year and are awarded a BA degree at the end of that year. Students take 3 hours of graduate coursework during their senior year under the senior privilege rule, which requires them to notify The Graduate School in advance of the course for graduate credit. Upon successful completion of the fifth year, the student receives the MBA degree.

DUAL J.D.-MBA PROGRAM

The College of Business Administration and the College of Law offer a concurrent dual program leading to the conferral of both the Doctor of Jurisprudence and the Master of Business Administration. The dual program saves the student approximately one semester over the time that would be required to earn both degrees independently.

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

Admission Requirements

Applicants for the J.D.-MBA program must make separate application to, and be competitively and independently accepted by, the College of Law for the J.D., The Graduate School and College of Business Administration for the MBA degree, and by the Dual Program Committee. Students who have been accepted by both colleges may apply for approval to pursue the dual program anytime prior to, or after, matriculation in either or both colleges. Such approval will be granted, provided that dual program studies be started prior to entry into the last 28 semester hours of J.D. coursework and prior to entry into the second year of the MBA program. Students interested in entering the dual degree program should submit a letter of application to the Dual Program Committee. Upon receipt of the application, the Dual Program Committee will determine eligibility and assign students to advisors who will be...
THE DOCTORAL PROGRAM

The primary objective of the Ph.D. in Business Administration is to prepare a select number of qualified students for careers in university-level teaching and research and for responsible positions in business and government.

Admission Requirements

Students seeking a Ph.D. degree must be recommended for acceptance by the College of Business Administration to The Graduate School. Actual admission is based on the applicant's overall standing compared with other applicants and with the number of vacancies in each department. The Graduate School requires the Graduate School Application, transcripts from all previous college work, and additional information from international students. The college requires the Ph.D. application, scores from the GMAT, and four written recommendations. All materials should be received by the Graduate School of Business Administration not later than March 1. Late applications are considered only if space is available.

Under exceptional circumstances, a student may be considered for acceptance into the Ph.D. program with a Master's degree. An applicant in this situation should have an outstanding undergraduate background and should represent a deep and sincere commitment to the pursuit of a career in research and instruction.

Program of Study

The Ph.D. normally requires at least three years of intensive study and research beyond the Master's degree. The first two years of a student's program consist of coursework, writing, and research. The third year usually focuses on completion of the dissertation research and writing. It is emphasized that the Ph.D. program of study is structured for full-time students only. Upon acceptance of a student by a particular departmental faculty, the student is expected to remain in the Ph.D. program for the duration of the program of study.

Since the program focuses on the development of competent scholars, heavy emphasis is placed on both teaching and research skills. As part of the doctoral program, each student is required to serve as a teaching assistant to an undergraduate business class or as a research assistant to a senior faculty member. Typically, the College of Business Administration offers financial support for doctoral students during their tenure in the program.

The Ph.D. program is highly flexible, offering a wide array of concentrations and cognates. Moreover, heavy emphasis is placed on individualized instruction and close student-faculty interaction. Instruction takes the form of regular classes, doctoral seminars, and independent study and research. Students are also encouraged to attend lectures and discussions by visiting scholars throughout the year.

There are five concentrations offered in the Ph.D. program: Accounting, Finance, Management (Operations Management and Strategic Management), Marketing, Logistics and Transportation.

More detailed information concerning these specific areas is available by writing directly to each department chairperson and by referring to the appropriate fields of instruction.

Degree Requirements

Doctoral students must file a program of study that has been approved by their temporary doctoral advisory committee and the Associate Dean for Graduate Business Programs by the end of the first semester of coursework after entry into the program. This committee is nominated by the department chairperson in a student's intended area of concentration, subject to the Graduate Council's policies and procedures. Following are specific degree requirements:

1. Students must complete at least three years of full-time coursework beyond the baccalaureate degree, with two years of residence on the Knoxville campus.

2. Students must complete appropriate courses at the graduate level, or other approved concentrations of coursework, in the following areas:

   - Accounting
   - Behavioral Science
   - Business Policy
   - Calculus
   - Computer Science
   - Economics
   - Finance
   - Legal Environment
   - Management
   - Marketing
   - Statistics

   All work in the above areas is subject to approval by the temporary doctoral advisory committee and the Associate Dean for Graduate Business Programs. Specific majors may have prerequisites not listed above.

3. Basic Core: Economics 510 (or approved substitute) is required, except that Management 567 (or equivalent) may be substituted with prior approval.

4. Research Tools: A minimum of 9 semester hours of graduate research methods must be completed. At least 6 semester hours in statistics courses beyond Statistics 531 are required. The remaining 3 semester hours may be completed in additional statistics courses (not to include Statistics 531) or in other areas such as research methodology, management science, computer science, econometrics, and psychometrics.

5. Concentrations: The concentration is the focal point of the Ph.D. program. Students are expected to master the literature and research techniques in the concentration area and to do quality research as evidenced by the preparation of an acceptable dissertation. A minimum of 12 semester hours of coursework is required, including at least 9 hours of doctoral seminars. Graduate work taken in the concentration at other institutions is considered by the temporary doctoral advisory committee in approving the specific coursework required. Available concentrations are: accounting, finance, management (operations management and strategic management), marketing, and logistics/transportation. A related area in another school or college of the University.

Approved Dual Credit

MBA courses to be counted toward the J.D. program must include Accounting 501, 503 or a more advanced graduate accounting course and 6 semester hours approved by the College of Business Administration to be counted toward the MBA must be selected from those approved by the Associate Dean for Graduate Business Programs.
Comprehensive Examinations

Comprehensive written examinations over the concentration and cognate areas are required of each person seeking candidacy for the Ph.D. The concentration area examination is administered in two sessions of approximately four hours each and the cognate area examination in one session of approximately four hours. Written examinations may be supplemented with oral examinations. For a doctoral student having a cognate area in the College of Law, the results of only an oral examination may be deemed acceptable. Scheduling of comprehensive examinations is coordinated through the Office of Graduate Business Programs. Comprehensive examinations are generally offered during the fall and spring terms. Comprehensive examinations must be taken within five years of matriculation.

When either the concentration or cognate area examination is passed, the remaining examination must be passed within the next 13 months.

Doctoral Committee

A doctoral student is advised to give serious attention early in the program to the composition of his/her doctoral committee. In accordance with Graduate School policy, the student and the major professor identify a doctoral committee composed of at least four faculty members, three of whom, including the chair, must be approved by the Graduate Council to direct doctoral research. When the doctoral committee has been formed, the temporary doctoral advisory committee ceases to exist.

Admission to Candidacy

Students may apply for admission to candidacy for the Ph.D. after maintaining a "B" average in coursework, successful completion of comprehensive examinations, and acceptance of a research proposal for the dissertation by the student’s doctoral committee. Admission to candidacy must be approved by the student’s doctoral committee. Application for admission to candidacy must include a listing of all courses taken in each of the fields required for the degree (business functional areas, basic disciplines, concentration and cognate area). Graduate courses accepted from other institutions must be included. Under "Other Requirements," the date of acceptance of the research proposal by the doctoral committee should be indicated. The application must be approved by the student’s doctoral committee and the Associate Dean for Graduate Business Programs before submission to The Graduate School.

Dissertation

Minimum of 24 semester hours. The student must complete a dissertation embodying the results of original research demonstrating the ability to do scholarly writing. The dissertation is supervised by the candidate’s doctoral committee, which must certify its completion and acceptability after oral defense of the candidate’s research effort.

The dissertation normally must be completed within three years of the student’s advancement to candidacy.

GRADUATE COURSES

501-03 Integrative Management I, II (1,1) Introductory integrative managerial policy and strategy for MBAs only. Use of tools of analysis, data, information, design, and remediation to identify, solve, and correct problems in and of organizations.

506 Management Information Systems (3) Analysis of organizational information needs, decision support systems, data base designs, data base software, computer utilization in data display, modeling, and strategies.

509 Managerial Policy and Strategy (3) Strategy and policy that affect character and success of total enterprise. Capstone course in all functional areas in formulation and implementation of strategy that enables organization to reach objectives. Prereq: MBA core.

510 Economics, Marketing and Management of Service Organizations (3) Unique cost, pricing, marketing and management issues created by the inability of service organizations to inventory output for later resale. Modification of traditional business concepts for organizations that manage service capacity rather than producing inventory.

599 Executive In-Residence (3) Interaction with corporate executives from wide spectrum of business disciplines and discussion of domestic and international strategic planning as applied in major corporations. Prereq: MBA core and consent of instructor.

Chemical Engineering

(Admission to Candidacy)

MAJOR

Chemical Engineering

DEGREES

Graduate programs lead to the degrees of Master of Science and Doctor of Philosophy in Chemical Engineering with concentrations in chemical engineering, chemical bioengineering, advanced control systems, and polymer science and engineering.

THE MASTER’S PROGRAM

The standard Master’s program includes a thesis and leads to the Master of Science. Minimum departmental requirements are as follows:

1. A total of at least 21 hours in graduate coursework in chemical engineering and related areas excluding thesis. The minimum requirements are 18 hours in chemical engineering, 3 hours in other engineering, scientific, or business areas (as approved by the departmental faculty); and 3 optional hours from either one of these two categories.


3. Active participation in graduate seminars in the department. Resident students must register for CHE 501 every semester it is offered.

4. A final oral examination covering the thesis, related fields and graduate coursework. Under certain conditions, a candidate may apply for a non-thesis program. To be eligible, a 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. The departmental faculty will consider each application individually. Upon acceptance, the requirements for completion of the non-thesis option are as follows:

1. A total of at least 33 hours in graduate courses in chemical engineering and related areas. The minimum requirements are 18 hours in chemical engineering; 6 hours in other engineering, scientific, or business areas (as approved by the departmental faculty); and 9 optional hours from either one of these two categories.

2. Completion of a critical review of the literature and other sources in an area related to chemical engineering (CHE 660).

3. A written comprehensive examination covering the major field and an oral examination covering the review paper and related areas.

THE DOCTORAL PROGRAM

Students applying for entrance into the doctoral program must submit 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 following completion:

1. Graduate courses in chemical engineering, amounting to approximately 24 semester hours, at least 9 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. These
related fields will normally include chemistry, mathematical physics, and engineering.

3. The comprehensive examination, consisting of a written part and an oral part. The written part covers thermodynamics, reactor analysis, and transport phenomena and separations.

4. Active participation in graduate seminars conducted by the department. Resident students must register for ChE 501 every semester offered.

GRADUATE COURSES

401 Chemical Engineering Data Analysis (3) Experimental data, identification of system extremes, statistical properties of samples; empirical modeling of processes; statistical process control; optimization techniques.

403 Introduction to Optimization (3) Principles and applications of optimization techniques to chemical process design; unconstrained and equality constrained optimizations, linear programming, dynamic programming, and geometric programming. Prereq: Mathematics 241.

415 Computer Applications in Chemical Engineering, introduction of chemical engineering problems. Application of existing software to personal computer programs. Flow sheet simulators, statistics, spreadsheets, graphics and process modeling.

440 Transport Phenomena (3) Momentum, heat and mass transport; analogies, differential and macroscopic balances, applications involving molecular diffusion, simultaneous mass transfer and chemical reaction.


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

501 Graduate Seminar (1) Prereq: Admission to graduate program. May be repeated. SNC 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 time before degree is completed. May not be used toward degree requirements. May be repeated. SNC only.

505 Engineering Analysis (3) Formulation and solution of problems in chemical, biological, and materials areas, ordinary and partial differential equations, types of CDE. PDE and solution techniques; transform methods; continuous and discrete; variational methods; introduction to numerical methods. (Same as Mathematics Engineering 505.)

506 Approximate Methods in Chemical Engineering (3) Chemical engineering problems requiring approximate solution; introduction to some approximate methods. Prereq. 505.

507 Application of Numeric Linear Algebra in Systems and Control Engineering (3) Fundamental concepts of linear algebra to problems in systems and control areas. Geometric and physical interpretations of relevant concepts: least square problems, LU, QR, and SVD decompositions of matrix, eigenvalue problems and similarity transformations in solving difference and differential equations. Numerical computational aspects of various algorithms. Application of linear algebra concepts in optimization, stability analysis, and introduction to linear programming, Computer projects. Prereq: Graduate standing or consent of instructor. (Same as Electrical and Computer Engineering 507 and Mechanical Engineering 507.)


531 Advanced Chemical Engineering Thermodynamics (3) Phase equilibrium in ideal and nonideal solution; composition relationship between phases, solution behavior and application to macromolecules; introduction to microscopic approach to thermodynamics.

541 Fluid Mechanics and Polymer Processing (3) (Same as Materials Science and Engineering 541.)

542 Diffusive and Stagewise Mass Transfer Operations (3) Analysis of mass transfer phenomena, coupled mass transfer and reaction techniques with application to packed towers and agitated vessels, membrane separations. Equilibrium stage concepts applied to mass transfer operations, recognizing nonisothermal and multicomponent systems.

551 Chemical Reactor Analysis (3) Rate models for heterogeneous reactions, properties of porous catalytic, reactor deactivation, fluid-fluid and fluid-solid reactors.

561 Process Modeling and Simulation (3) Theories and structures of models and art of simulation. Model development from basic principles. Model development from plant test. Use of models in operation, optimization and control. Prereq: Consent of instructor.

575 Applied Microbiology and Bioengineering (3) Crossdisciplinary course combining basic concepts in microbiology, biochemistry, reaction kinetics, and biochemical and environmental engineering. Commercial processes. Biodegradations/wastewater treatment, analysis of biochemical reactor systems, biosensors, and immobilization methods. Fundamental laboratory techniques during 6-week laboratory period. (Same as Environmental Engineering 575 and Microbiology 575.)

576 Principles of Chemical Separations (3) Fundamental aspects of chemical and biochemical separation methods with emphasis on separations as unified field, physical/chemical separations with applications from both chemical and biochemical fields; development of predictive mathematical models.


590 Technical Review and Assessment (3) Preparation of critical review of literature in area related to chemical engineering. Limited to candidates in nonthesis option. Prereq: Consent of instructor.

585 Process System Reliability and Safety (3) (Same as Nuclear Engineering 585.)

586 Measurement Science I (3) (Same as Nuclear Engineering 586, Civil Engineering 588, Electrical and Computer Engineering 588, Environmental Engineering 588, Mechanics and Mechanical Engineering 588, and Aerospace Engineering 588.)

587 Measurement Science II (3) (Same as Nuclear Engineering 589, Civil Engineering 589, Electrical and Computer Engineering 589, and Engineering 589, Engineering Science and Mechanics 589, Mechanical Engineering 589, and Aerospace Engineering 589.)
chemistry (at the 400 level or above) and/or a performance on entrance examinations.

THE MASTER'S PROGRAM

The department offers concentrations in six areas for the M.S.: analytical chemistry, environmental chemistry, inorganic chemistry, organic chemistry, polymer chemistry, and physical chemistry. The requirements for the M.S. in Chemistry consist of the satisfactory completion of:

1. Research and a dissertation to give at least 24 hours of graduate credit in Chemistry 600. Registration must be continuous from the beginning of research.

2. Participation in seminar (Chemistry 501) during the entire period of graduate study, including the presentation of at least one seminar.

3. Prescribed remedial courses based on performance on entrance examinations.

4. Completion of the comprehensive examination series and defense of an original research proposal to give 2 hours of credit in Chemistry 660.

5. Demonstration of a reading knowledge of French, German, Russian, or an alternative approved by the Chemistry faculty.

6. Eighteen additional hours in courses at the 500 level or above including at least one course above 501 and one of the following sequences: 510-11-12, 530-11-32, 550-51-52-53-54, 570-71-72-73, and 590-94-95.

7. A final oral examination.

The Ph.D. concentration in chemical physics is conducted jointly with the Department of Physics. Requirements depend on the choice of the major department. Chemistry departmental requirements include passing the above degree requirements in chemistry concentration in physical chemistry plus 6 additional hours in physics at the 500 level or above. Three of the additional physics hours can be used to satisfy the 18 hours requirement in Item 6.

GRADUATE COURSES

430 Advanced Inorganic Chemistry (3) Atomic and molecular structure, bonding theories, descriptive chemistry of elements, kinetics and mechanism of inorganic reactions, applications of modern techniques for characterization, coordination and organometallic chemistry. Prereq: 230. Prereq or coreq: 380 or 381. Sp

431 Radioactivity and Its Application (2) Radioactive materials in tracer applications. Radioactive decay, detection apparatus and techniques, tracer procedures, safety precautions in agriculture, biology, medicine, nutrition. Not for credit by chemistry or physics majors or minors. Prereq: Mathematics 122 or equivalent and 1 yr of general chemistry. Sp


471-81 Biophysical Chemistry (3,3) (Same as Biochemistry 471-81.)

473-83 Physical Chemistry (3,3) Students may not receive credit for both 473 and 473 or for both 483 and 483, 473. Properties of gases; first, second, and third laws of thermodynamics; chemical equilibrium; simple phase equilibria; properties of solutions; introduction to statistical thermodynamics: 483. Kinetics of chemical reaction; introduction to quantum mechanics and applications to electronic structure of atoms and molecules; molecular spectroscopy. Prereq: General chemistry, fundamentals or elements of physics, and calculus. E

479-89 Physical Chemistry Laboratory (2,2) Experiments on topics discussed in 471-81 or 473-83. Prereq or coreq: Corresponding courses 471 or 473 for 479 and 483 or 487 for 489. 1 lab. F

484 Advanced Physical Chemistry (3) Chemical dynamics, statistical thermodynamics, quantum mechanics of atomic and molecular systems in solid state and crystal. Prereq: 481 or 483. Sp

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

501 Chemistry Seminar (1) Lectures and discussion on current research. May be repeated. Continuous registration required for resident graduate students. S/NC only. F,Sp

502 Registration for Use of Facilities (1-15) Required for the student not otherwise registered during any semester when student uses University facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. Maximum 6 hrs. S/NC only.

510 Analytical Spectrometry (3) Principles and practice of optical and mass spectrometric techniques in quantitative chemical analysis. Prereq: 1 yr of physical chemistry.

511 Analytical Separations (3) Principles and practice of chemical separations based on extraction, chromatographic, and electrophoretic phenomena. Prereq: 1 yr of physical chemistry.

512 Electroanalytical Chemistry (3) Fundamentals of electrode processes; principles and practice of electroanalytical techniques in quantitative chemical analysis and applications to real chemical systems. Prereq: 1 yr of physical chemistry.

520 Chemical Instrumentation (3) Principles of analog and digital systems in chemical instrumentation; practice in design and construction of chemical instruments. Prereq: Consent of instructor.

530 Chemical Bonding (3) Wave mechanical atomic, group theory, quantum approach to molecular orbital theory, covalent, ionic, and metallic bonding, ligand field theories, solid state. Prereq: 1 yr of physical chemistry. F

531 Characteristics of Inorganic Compounds (3) Descriptive chemistry of elements, structure, reactions, kinetics, mechanisms, equilibria, and spectra of coordination, organometallic, inorganic compounds. Prereq: 530. Sp

532 Experimental Methods of Inorganic Chemistry (3) Electronic, infrared, Raman, microwave, NMR, ESR, nuclear quadrupole, Mossbauer, mass, and photoelectron spectroscopies for characterization of inorganic compounds. Prereq: 530. F

540 Nuclear and Radiochemistry (3) Nuclear properties, radioactivity, radioactive decay processes, nuclear structure and models, nuclear reactions, radiations and detectors, radiation detection. Prereq: 1 yr of physical chemistry.

550 Structure and Reactivity in Organic Chemistry (3) Structure and bonding in organic compounds; molecular orbital theory, stereochemistry, conformation analysis, and molecular mechanics: substituent effects on acidity and reactivity; introduction to reaction mechanisms. Prereq: 360. F


552 Organic Reaction Mechanisms (3) Techniques and principles in study of organic reaction mechanisms; applications and interpretations in polar, radical, and pericyclic reactions; reactive intermediates. Prereq: 550. F

553 Spectroscopic Characterization of Organic Compounds (2) Organic structure elucidation using spectroscopic methods: nuclear magnetic resonance, infrared, ultraviolet and mass spectrometry. Prereq: 360 or equivalent. E

554 Organic Spectroscopy Laboratory (1) Use of IR, MS, and multinuclear NMR spectrometers. Development of problem-solving ability in area of spectroscopic characterization of organic molecules. Prereq: 360 or equivalent. Coreq: 553. Sp

570 Quantum Chemistry and Spectroscopy (3) Basic principles of quantum mechanics and their applications to molecular orbital theory, molecular structure, and spectroscopy; introduction to group theory. Prereq: 1 yr of physical chemistry. F
Selected Topics in Physical Chemistry
Selected Topics in Analytical Chemistry
Selected Topics in Organic Chemistry


595 Physical Chemistry of Polymers (3) Conformation of macromolecules, solution and bulk properties, rubber elasticity, kinetics of polymerization, polymer thermodynamics. Prereq: 1 yr each of organic and physical chemistry. Sp

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

601 Chemistry Research Proposal (2) Preparation and oral defense of original written research proposal based on thorough survey of chemical literature. Prereq: Consent of department head. S/NC only. E

610 Selected Topics in Analytical Chemistry (3) Topics of current significance. Prereq: 510-11-12 or consent of instructor. May be repeated. Maximum 12 hrs.

630 Selected Topics in Inorganic Chemistry (3) Topics of current significance. Prereq: 530-31-32 or consent of instructor. May be repeated. Maximum 12 hrs.

650 Selected Topics in Organic Chemistry (3) Topics of current significance. Prereq: Two of 550-51-52 or consent of instructor. May be repeated. Maximum 12 hrs.


670 Selected Topics in Physical Chemistry (3) Topics of current significance. Prereq: 570-72-73 or consent of instructor. May be repeated. Maximum 12 hrs.

690 Selected Topics in Polymer Chemistry (3) Topics of current significance. Prereq: Consent of instructor. May be repeated. Maximum 12 hrs.

Professors:
Cunningham, Jo.Lynn, Ph.D. ... Michigan State
Fox, Greer L., Ph.D. .......... Michigan
Nordquist, V. Mick, Ph.D. .......... Tennessee
Twardsz, Sandra, Ph.D. .......... Kansas
White, Priscilla, Ed.D. .......... Tennessee

Associate Professors:
Alien, J., Ph.D. ............... Purdue
Buehler, C., Ph.D. .......... Minnesota
McInnis, Jackie H., Ph.D. .......... Florida State

Barber, B., Ph.D. ............... Brigham Young
Blinn, L., Ph.D. .......... Ohio State
Catron, C., Ed.D. .......... Vanderbilt
Smith, Delores, Ph.D. .......... Oklahoma State
Tegano, D., Ph.D. .......... Virginia Tech

The Department of Child and Family Studies encompasses two primary concentrations: child development and family studies. Integration of theoretical and empirical perspectives is a unique feature for the study of individuals and families. Each graduate student's program is individually planned in conjunction with a faculty advisor to establish a program consistent with individual goals. All programs are characterized by a broad array of coursework, varied research experiences, opportunities for experiences in applied settings.

Because the doctoral degree is a research degree, students at this level receive substantial preparation in statistics and research methodology. Interested students should contact the department head.

ADMISSION REQUIREMENTS
A completed file for review includes a College of Human Ecology application, Graduate Record Examination (GRE) scores for the general section, and completion of three Graduate School Rating Forms by individuals who can attest to the potential for graduate work, varied research experiences, and opportunities for experiences in applied settings.

Because the doctoral degree is a research degree, students at this level receive substantial preparation in statistics and research methodology. Interested students should contact the department head.

THE MASTER'S PROGRAM
An individual program of study may be designed by the student in collaboration with his or her major professor and committee. The program provides for a concentration in either child development or family studies. Students seeking the M.S. in Child and Family Studies are required to file a plan of study with the department head after 15 hours of graduate credit have been completed.

THE PH.D. CONCENTRATION
The doctoral program in Human Ecology prepares scholars in the concentration areas of child development and family studies. The strength of the doctoral program is based on three major components: the integration of child development and family studies within the context of human ecology and related areas, concentration in either area of specialization, and an emphasis on becoming proficient producers and consumers of research. A doctoral program that is concurrently specialized and integrative in nature refines the complexity of the disciplinary subject matter, provides a broader context to formulate theoretical questions, and broadens the empirical literature for addressing those questions.

Requirements include:
1. Minimum 13 credits in child and family studies required foundation courses: 510, 511, 550, 570, 571;
2. Minimum 12 credits in 500- and 600-level courses in child development or family studies, with at least 3 credits in 600-level courses (in addition to the required courses described in #1);
3. Minimum 6 credits in a cognate area;
4. Minimum 9 credits in graduate-level statistics; with at least 3 of these credits in a more specialized area than a sequence of survey courses;
5. Minimum 3 credits of specialized research methods;
6. Pre-doctoral research project approved by student's committee;
7. College Professional Seminar, Human Ecology 610;
8. Minimum 8 credits of electives;

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 Survey of Theory and Research in Child Development (3) Theoretical models and research literature in child development (conception through adolescence); application to research, interaction and education. Prereq: 9 hrs of either upper division undergraduate or graduate social science or consent of instructor. F

512 Survey of Research in Early Childhood Education (3) Current literature and studies in early childhood education. Prereq: 510 or equivalent or consent of instructor. Sp


521 Organizational Management in Early Childhood Education (3) Designing, implementing, and evaluating physical and human resources in educational environments. Development of skills in educational organization, interpersonal skills and supervision staff. Prereq: 512 or equivalent or consent of instructor. Sp

522 Naturalistic Interventions for Parents and Teachers of Young Children (3) Common problems faced by parents and teachers; methods available to modify problem behavior. Prereq: 510 or equivalent or consent of instructor. F,A

530 Families of Handicapped Children (3) Developmental nature of families' experiences in caring for handicapped children, especially during infancy and early childhood. Prereq: 510 or consent of instructor. Sp

533 Peer Relations (3) Influence of peers on children, influence of children on parents, reciprocal interaction between parents and children, applications of systems models, child abuse, and impact of divorce on children. Prereq: 550 or equivalent or consent of instructor. F

556 Survey of Theory & Research in Family Studies (3) Research issues and literature in family studies; use of family conceptual frameworks, development of theoretical models and application to research and family life programs. F

560 Marital Dyad (3) Communication, power, sexuality, marital stability, and marital satisfaction. Prereq: 550 or equivalent or consent of instructor. F

561 Family Resource Management and Decision-making (3) Management concepts, development and application to family situations. Prereq: 550 or equivalent or consent of instructor. F,A


563 Family Life Education Programs (3) Planning, implementing, and evaluating programs in marital, parental, and family relationship, and parenthood education. Prereq: Consent of instructor. (Same as Home Economics Education 563.) F,A

564 Practicum in Human Development or Family Studies II (3) School and community programs conducted with education for human development and family living. Consent of instructor. S/NC only, E

565 Practicum in Human Development or Family Studies I (3) Social and community programs conducted with education for human development and family living. Committee approved and supervised written project. Prereq: 564 and consent of instructor. E

566 Approaches to Family Intervention and Counseling (3) Various theoretical approaches for family intervention and counseling. Structural, strategic, experiential and social learning schools of practice. Effects of intervention from perspective of their impact on family functioning and communication. Prereq: 562. (Same as Educational and Counseling Psychology 566). Sp,A


571 Research Seminar (1) Presentation and critique of research projects. Prereq: Departmental major or consent of instructor. May be repeated. S/NC only. S

580 Special Topics in Human Development or Family Studies (1-3) Research, theory and current issues in child development or family studies: divorce, handicapped children, symbolic interaction, work and family, Piaget, mainstreaming children, theory and research in human sexuality, cognition. Prereq: 6 graduate hrs in major, or consent of instructor. May be repeated with different topics. Maximum 9 hrs. E

581 Directed Study in Human Development or Family Studies (1-3) Individual learning experiences in specific topics in child development and early childhood education or family studies. Prereq: 6 graduate hrs or consent of instructor. May be repeated with different topics. Maximum 6 hrs. E

589 Assessment of Development and Learning in Young Children (3) Theory, empirical research and practical issues related to measurement of development and learning in young children. F,A

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

610 Advanced Special Topics in Human Development or Family Studies (1-3) Study of research and theory related to current issues. Prereq: 12 graduate hrs in major or consent of instructor. May be repeated with different topics. Maximum 6 hrs. E

620 Advanced Directed Study in Human Development or Family Studies (1-3) Advanced, in-depth individualized learning experiences in specific topics in child development, early childhood education, or family studies. May be repeated with different topics. Maximum 6 hrs.

630 Advanced Study in Infant and Early Childhood Development (3) Normative and nonnormative development during infancy and preschool years of life: cognitive, emotional, social, and physical aspects. Prereq: 510 or equivalent or consent of instructor. F,A

631 Adolescent Development in Families (3) Normative and nonnormative adolescent development: physical, cognitive, moral, social, familial, sexual, and personal aspects. Prereq: 510 or equivalent or consent of instructor. F,A

632 Advanced Study in Family Interaction (3) Human communication and conflict management within family context. Theoretical perspectives for familial processes, adjustment, decision-making, and coping. Prereq: 550 or equivalent or consent of instructor. Sp,A

Civil Engineering

(College of Engineering)

MAJORS

DEGREES

Civil Engineering............................................ M.S., Ph.D.
Environmental Engineering............................. M.S.

Gregory D. Reed, Head

Professors:

Burdette, Edwin G. (Fred N. Peebles Prof.), PE, Ph.D. .......... Illinois
Chatterjee, Arun, PE, Ph.D. ................. NC State
Davis, Wayne T., Ph.D. ...................... Tennessee

Civil Engineering

The Department of Civil Engineering offers degrees leading to the Master of Science and Doctor of Philosophy with a major in Civil Engineering concentrating in construction engineering, environmental engineering, geotechnical/materials engineering, public works engineering, structural engineering, and transportation engineering; to the Master of Science in Environmental Engineering with concentrations in water quality, water resources, air quality, mixed waste management, and waste management.

THE MASTER'S PROGRAM

The Master of Science programs in Civil Engineering and Environmental Engineering are offered to graduates of recognized undergraduate curricula. Departmental requirements provide that for a major in Civil Engineering, the Bachelor's degree must be in civil engineering, or certain undergraduate prerequisite courses must be taken before admission to candidacy for the Master of Science in Civil Engineering.

Thesis Option: A minimum of 30 semester hours, including 6 hours of thesis, is required. Non-Thesis Option: A minimum of 33 semester hours, including a 3-hour special
problems is required. The special problem will culminate in a written report which must be approved by the student's major professor.

Environmental Engineering
For a Master of Science with a major in Environmental Engineering, normally a Bachelor's degree in a field of engineering is required. For a student who does not have an engineering background, the following minimum prerequisite courses will be required: Basic Engineering or Computer Science 101; Basic Engineering 121, 131; Engineering Science and Mechanics 231, 321; Civil Engineering 390, 395, 397; Mathematics 141, 142, 231, 241; Chemistry 120, 130. In general, these must be completed before courses for graduate credit can be taken.

The Department of Civil Engineering offers both thesis and non-thesis options for work toward the Master of Science degree in Environmental Engineering.

Thesis Option: The student must present a minimum of 30 semester hours of approved graduate courses. The major shall include 6 semester hours of thesis and a minimum of 12 semester hours of approved environmental engineering coursework. A minor may be selected but is not necessarily required.

Non-Thesis Option: The student must present a minimum of 33 semester hours of approved graduate courses. The major shall include a minimum of 18 semester hours of approved environmental engineering coursework. A minor may be selected but is not necessarily required.

Either option must be approved by the student's major professor. A student's program must include at least 3 semester hours of advanced engineering design courses selected from a list provided by the student's committee. Normally, the graduate program of study will be adjusted by the head of the department and the student's committee to suit the individual academic objectives.

THE DOCTORAL PROGRAM
A graduate program leading to the Doctor of Philosophy is offered in Civil Engineering.

Specific departmental requirements for the Ph.D. degree include the following:
1. A minimum of 72 semester hours beyond the Bachelor's degree, exclusive of credit for the M.S. thesis. Of this number, a minimum of 24 semester hours in 600 Doctoral Research and Dissertation will be required.
2. A minimum of 24 semester hours of graduate courses in civil engineering, exclusive of thesis or dissertation credit, at least 6 hours of which must be 600-level courses.
3. Supporting courses in related scientific and engineering fields, amounting to approximately 24 semester hours, subject to approval by the student's faculty committee. These related fields will normally include such disciplines as mechanics, chemistry, mathematics, microbiology, physics, and other engineering fields. A minimum of 9 semester hours of mathematics will be required beyond the civil engineering undergraduate requirements.
4. One foreign language if the student's faculty committee feels that a reading knowledge of a foreign language is crucial to the student's research efforts.
5. Upon completion of at least one-half of all coursework, each student must pass a comprehensive examination.
6. After completion of the dissertation, prior to graduation, each student must pass a comprehensive examination administered by a faculty committee.

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 Environmental Engineering is available to residents of the state of Alabama. Additional information may be obtained from the Residency Assistant in the Office of Graduate Admissions and Records.

Civil Engineering

GRADUATE COURSES

406 Legal and Ethical Aspects of Engineering (2) Legal principles underlying engineering work; laws of contracts, torts, real property; problems of professional registration and ethics. Prereq: Senior standing.

410 Land Surveying (3) Procedures of locating proper ties; evaluating evidence; procedures to describe property; to create plats and to prepare plats, laws of land surveying. Prereq: 210.

421 Portland Cement and Asphaltic Concrete (3) Aggregate properties and tests; tests of Portland cement concrete, mix design methods for concrete and asphalt, concrete admixtures, tests of asphalt and asphalt mixes, and nondestructive testing. Prereq: 321. 2 hrs and 1 lab.

451 Highway Engineering (3) Design, construction, operation, and maintenance of highway facilities; application of various engineering principles and techniques to process of planning, locating and design of highway facilities; both geometric and pavement design. Prereq: 210, 251, 352.

452 Traffic Engineering (3) Characteristics of driver, vehicle, and roadway and their interaction; traffic studies; basic considerations of traffic circulation and control, lighting, capacity analysis, roadway safety analysis and design. Prereq: 210, 251, 352.

453 Airport/Railroad Planning and Design (3) Airport master planning and railroad engineering. Runway configuration, airport layout and design, terminal layout and design. Railroad capacity, geometrics and system layout and design. Prereq: 210, 251, 352.

461 Analysis of Framed Structures (3) Maximum stress due to moment/loads; use of influence lines; lateral forces due to earth/loads; design of portals, building frames, and space frames; matrix methods; use of computer in structural analysis. Prereq: Analysis of Framed Structures I.

472 Steel Design (3) Design of plate girders and composite beams; consideration of members subjected to combined stresses; design of typical framed building, connections. Prereq: 471.

474 Reinforced Concrete Design (3) Reinforced concrete continuous beams and floor slabs, columns with combined axial loads and bending, footings and retaining walls. Prereq: 335.

485 Principles of Geohydrology (3) (Same as Geological Sciences 485.)

490 Water Resources Project Design (3) Coherent development of multipurpose reservoir and dam project, data acquisition; spillway and control works design; earthen and gravity dam stability analyses; drains and filters; maintenance and operation principles; and dam safety concepts, dam break analyses. Prereq: 395, 397.

494 Urban Drainage Engineering (3) Design and management of stormwater conveyance and control structures. Application of hydraulic and hydraulic principles to design of drainage systems for urban, strip mining, and highway development; design of inlet structures, ditches, culverts, and detention/retention basins; application of commonly-used computer runoff models; evaluation of land-use on streamflow quantity and quality. Prereq: 390, 395.

495 Water Resources Development and Management (3) Principles and practices of water resources development and management. Institutional framework: water law, evaluation procedures for comparing and selecting among development alternatives, multi-objective planning, principles of engineering economics, benefit-cost analysis, and cost allocation methods; environmental impact assessment procedures; decisions using risk-based methods; case studies. Prereq: Senior standing.

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 or/and facility time before degree is completed. May not be used toward degree requirements. May be repeated. S/N/C only. E

506 Seminar (1) Reports on current research in civil engineering at UT. Prereq: Graduate standing.

510 Urban Systems: Engineering and Management (3) Various urban systems usually under responsibility of city manager and/or city engineer: streets, lighting, wa- ter, sewerage, refuse collection. Personnel manage- ment, finance, planning and public relations. Prereq: Graduate standing.


531 Soil Stabilization (3) Mechanical stabilization of soils on further development of methods of stabilization of soils with admixtures, waterproofing and modifying of soils and additives. 2 hrs and 1 lab.


535 Advanced Foundations and Retaining Structures (3) Planning subsurface investigations; bearing capacity and settlement of shallow foundations on lay- ered soils; settlement of footings and piles; design of piles, foundation design with pressure-meter, lateral earth pressures and design of retaining structures and sheet piles. Prereq: 330.


539 Geomechanics Seminar (1) Seminar topics in materials, geotechnical engineering and geomechanics. Graduate student research contributions and practical applications presented by practicing engineers from community. Prereq: Graduate standing and consent of advisor. May not apply toward degree. May be repeated. S/N/C only.


541 Construction Management II (3) Management organization of heavy and building construction projects. Prereq: 340.

543 Construction Estimating (3) Project costs, esti- mating, take-off, TAKEOFF, and budgeting; cost control, and feasibility of design to cost. Prereq: 340 or consent of instructor.

GRADUATE COURSES

533 Environmental Engineering Chemistry (3) Theoretical, applied and analytical chemistry related to generation, measurement and treatment of environmental contaminants. Prereq: Chemistry 130; 2 hrs and 1 lab.

555 Solid Waste Management (3) Magnitude and characteristics of solid waste problems; collection systems; design of disposal systems: landfill, incineration, and composting, design of resource recovery systems; current and future regulations. Prereq: Senior standing.

556 Hazardous Waste Management (3) Analysis and design of operations and processes for hazardous waste disposal and processing: regulations, analytical, industrial applications. Prereq: Graduate standing or consent of instructor.

570 Air Quality Management/Pollution Control (3) Introductory course on concepts of air pollution, analysis of relationships among sources, meteorology, effects; stack sampling; emission control systems. Prereq: Consent of instructor.

571 Design of Air Pollution Control Systems (3) Design and evaluation of systems used to control emission of gaseous and particle air pollutants. Comprehensive design of specific devices and systems. Prereq: 570.

572 Air Quality Dispersion Modeling (3) Diffusion in atmosphere; application of atmospheric dispersion models and evaluation of meteorological and air quality data. Prereq: Consent of instructor.

573 Sampling of Air Pollutants (3) Standard sampling methods for particulate and gaseous air pollutant emissions from industrial processes; ambient air monitoring instrumentation/techniques. Prereq: Consent of instructor.

575 Applied Microbiology and Bioengineering (3) (Same as Chemical Engineering 575 and Microbiology 575.)

590 Special Problems in Environmental Engineering (1-6) Enrollment limited to environmental engineering students in non-thesis program. Prereq: Graduate standing. May be repeated. Maximum 6 hrs. SNC only.

595 Special Topics (1-4) Problems and topics related to current developments in field. May be repeated.

596 Special Readings (1-4) Readings related to current developments in field. May be repeated.

620 Advanced Surface Water Hydrodynamics (3) Advanced topics in surface water hydraulics; solutions in current developments in field. May be repeated.

630 Advanced Stormwater Modeling (3) Advanced topics in stormwater modeling; stormwater quality modeling; advanced applications of available stormwater computer models. Prereq: 560.

651 Industrial Waste Unit Operations and Processes (3) Theoretical design and laboratory modeling of industrial waste treatment processes and operations. Prereq: 551, 552; 2 hrs and 1 lab.


653 Pollutant Fate Modeling and Risk Assessment (3) Application of scientific principles concerning movement and fate of chemicals at interfaces of air, water, and earth and solid environments. Methods of assessing risk posed by presence of those chemicals. Prereq: 551.

675 Microbial Systems Analysis (3) (Same as Chemical Engineering 675.)

691 Special Topics in Environmental Engineering (3) Selected advanced problems of current interest. Prereq: Consent of instructor. May be repeated.

541-42 The Latin Epic: Lucretius, Vergil (3,3) Advanced study of epic masterpieces of Lucretius and Vergil; both Georgics and Aeneid of Vergil.

561 Special Topics in Classical Civilization (3) Advanced tutorial work in Greek and Roman authors in English translation; problems in cultures of Greece and Rome. May be repeated. Maximum 9 hrs.

562 Problems in Old World Archaeology (3) Selected topics and research problems in European, Asian, and African prehistory. Prereq: Consent of instructor. May be repeated. Maximum 9 hrs. (Same as Anthropology 562.)

Communications

(College of Communications)

MAJOR

DEGREES

Communications ........................................ M.S., Ph.D.

Professors:

Ashdown, Paul G., Ph.D. .................. Bowling Green
Crook, James A., Ph.D. .................. Iowa State
Everett, George A., Ph.D. .................. Iowa
Holt, Darrell W. (Emeritus), Ph.D. .... Northwestern
Howard, Herbert H., Ph.D. ............. Ohio
Leiter, B. Kelly, Ph.D. ................. Southern Illinois
Singletary, Michael W., Ph.D. ........ Southern Illinois
Swan, Norman R., Ph.D. ............... Missouri

Associate Professors:

Bowles, Dorothy, Ph.D. ................. Wisconsin
Hovland, Roxanne, Ph.D. .............. Illinois
Miller, M. Mark, Ph.D. ............ Michigan State
Moore, Barbara A., Ph.D. .............. Ohio
Stankey, Michael J., Ph.D. ........... Illinois
Taylor, Ronald E., Ph.D. .............. Illinois

Assistant Professors:

Buchman, Joseph, Ph.D. ................ Indiana
Caudill, C. Edward, Ph.D. .......... North Carolina
Hoy, Maria, Ph.D. ....................... Oklahoma State
Manning-Miller, Carmen, Ph.D. ...... Indiana
Ziegler, Dhyana, Ph.D. ............... Southern Illinois

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

For application forms and other information about the M.S. and Ph.D. programs in Communications, write to: Assistant Dean for Graduate Studies, College of Communications, 98 Communications Building, The University of Tennessee, Knoxville, TN 37996-0313.

ADMISSION REQUIREMENTS

Applicants must meet admission requirements of The Graduate School. In addition, they must complete the Graduate Record Examination and application forms as required by the College of Communications. Minimum requirements for admission to full potential candidate status normally include a 3.0 (4.0 system) grade-point average in undergraduate studies and scores above the fiftieth percentile in verbal and quantitative aptitude on the Graduate Record Examination. All application materials are screened by an admissions committee authorized by the faculty of the College of Communications.
New students normally are admitted to the programs only at the beginning of fall semester. However, under special circumstances, a student may be admitted at the beginning of spring semester in a temporary non-degree status. Applications for fall admission must be received by May 1. Applications for financial aid are due by March 1.

A baccalaureate degree in communications or a related field is recommended. Admission is possible with other baccalaureate degrees. However, all applicants without the appropriate background are required to take up to 18 semester hours of prerequisite and corequisite courses as determined by the department in which the student is enrolled. Students may take a proficiency test on any prerequisite course, subject to review by the Master's or Doctoral Committee of the College of Communications.

Students who have had no courses in their major area of concentration may expect to spend four or more full-time semesters in the program, including a media internship.

ACADEMIC COMMON MARKET

An agreement among southern states for sharing graduate programs allows legal residents of some states to enroll in graduate programs at UT Knoxville on an in-state tuition basis. The Ph.D. program in Communications is available to residents of the states of Alabama, Arkansas, Louisiana, South Carolina, Virginia, or West Virginia. Additional information may be obtained from the Residency Assistant in the Office of Graduate Admissions and Records.

ACADEMIC STANDARDS

A student in the College of Communications whose graduate grade-point average, not including incomplete grades, is below 3.0 at any time after the end of 12 semester hours of graduate credit will be placed on probation. A student on probation will be dropped from the program unless his or 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 12 semester hours of graduate coursework attempted that is specified in the student's degree program. Exceptions to this policy may be made only with the approval of the Assistant Dean for Graduate Studies of the College of Communications on the recommendation of the student's faculty committee.

THE MASTER'S PROGRAM

The Master of Science with a major in Communications is intended for students who desire a career in the mass media with an emphasis on communications management and a deeper understanding of the communication process and social role of the mass media. The program follows a broad-based multi-media approach while allowing the student to concentrate in one of a number of fields: advertising, broadcasting, journalism, or public relations.

The prospective student who is interested only in acquiring basic skills in one of the areas listed above is advised to enroll for a second baccalaureate rather than an advanced degree.

Degree Requirements

The M.S. program emphasizes communications management, advertising, broadcasting, journalism (publications), and public relations. A minimum of 31 hours of approved graduate work is required:

1. Ten hours of core courses: Communications 510, 512, 540, and 550, the first three of which must be taken during the first two semesters of the student's program, except with written approval of the Assistant Dean for Graduate Studies for the College.
2. Twelve hours within one department of the college, at the 500 level or above. An internship, if needed, is included.
3. Three-hour elective from a list provided by the department in area of concentration.
4. Six hours of thesis work (Communications 590), including a thesis seminar.

Additional hours may be required for those who do not have academic prerequisites, and an internship may be required for those who do not have professional experience in the field they wish to study. A course in communications law is a prerequisite.

A student's internship experience requires approval by his/her advisor. Credit will be given through Advertising 598, Broadcasting 598, or Journalism 598 for an equivalent of 15 weeks of full-time professional experience. This credit is to be included in the student's 31-hour M.S. program. Previous professional experience will be evaluated by the student's advisor.

Students interested in subsequent entry into a doctoral program are advised to take additional courses in communications theory and research, subject to advisor's approval.

Additional courses and a media internship are required for students interested in subsequent entry into a doctoral program. Students must pass an oral examination conducted by his/her graduate committee.

Communications majors in the M.S. program must demonstrate ability to use a typesetter proficiently within their first semester in residence.

THE DOCTORAL PROGRAM

The Ph.D. with a major in Communications is intended to prepare scholars for teaching, research, administration, and service in the field of mass communications.

The program is interdisciplinary, consisting of a required core curriculum and recommended courses outside the College in the related social and behavioral sciences. The program is flexible and will accommodate a wide variety of career goals in communications. New students may be admitted to the program at any time; however, core courses begin only in the fall semester.

The Master's degree is not required for entry into or completion of the doctoral program. Program planning, however, will permit the Master's degree to be earned if desired. Students lacking academic or professional experience in communications will be required to take prerequisite courses. In general, however, the program may be completed within three academic years of full-time study beyond the Bachelor's degree. Those holding Master's degrees should anticipate two or more years of full-time study for completion of the Ph.D.

The following are normally minimal requirements for admission to full potential candidacy:

1. a 3.0 (4.0 system) grade-point average in undergraduate studies, or 3.5 for graduate work if applicant holds a Master's degree;
2. above the fiftieth percentile in verbal and quantitative aptitude on the Graduate Record Examination;
3. endorsement by at least three former teachers or professional colleagues; and
4. a statement of the applicant's goals and reasons for pursuing the doctorate. Personal interviews with members of the Ph.D. Admissions Committee are recommended and may be required. Professional experience in some field of communications is a highly desirable criterion for admission.

A minimum of 88 hours of approved graduate work is required for the Ph.D.

1. Twenty-eight hours of core courses: Communications 610, 612, 620, 640, 641; 6 hours of statistics; and three of the following courses: Communications 622, 632, 642, 652, and 692.
2. Fifteen hours in a primary concentration (advertising, broadcasting, journalism, public relations, or speech communications).
3. Twelve hours in a second concentration (outside the College of Communications).
5. Twenty-four hours of dissertation.

*Specific courses to be taken require the approval of student's advising committee.

Admission to candidacy must be attained at least two semesters prior to graduation and requires successful completion of a written comprehensive examination.

Each doctoral student's progress will be reviewed annually by the Doctoral Committee of the College of Communications. Results will be reported to the student by his/her program advisor, who will convey the committee's recommendation concerning the student's remaining in the program (non-binding) and suggestions for improvement in performance.

Candidates without prior teaching experience must register for Communications 521, Tutorial in Communications Teaching.

Planed course offerings in the College of Communications for a full calendar year are published in the College newsletter the preceding November. This information is available from the Dean's Office, 302 Communications Building, 974-3631. See also courses listed under Advertising, Broadcasting, and Journalism.

GRADUATE COURSES

400 Mass Communications Law and Ethics (3) Legal issues directly affecting the mass media: libel, privacy, free press-fair trial, judicial controls, governmental regulations. Ethical standards and practices of mass media in America. Prereq: Writing for Mass Communication or consent of instructor. 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 fallcy time before degree is completed. May not be used toward degree requirements. May be repeated. S/N only. E

510 Orientation to Master's Studies (1) Degree and thesis requirements. Committee formation and program planning. Overview of research methods and informational sources. Prereq: Consent of instructor or admission to program. S/N only. F

512 Fundamentals of Media Research (3) Applications of communications research techniques for management. Gathering and analysis of data for assessing media audiences and message impacts. Prereq: Consent of instructor or admission to program. Sp

521 Tutorial in Communications Teaching (1) Experience as teacher under guidance of faculty member. Prereq: Consent of instructor. S/N only. E

540 Theory for Media Management (3) Selected research hypotheses and theories in literature of mass
Comparative and Experimental Medicine

(Office of the Provost)

MAJOR DEGREES

Comparative and Experimental Medicine .............. M.S., Ph.D.
L. N. D. Potgieter, Chair

Joint Graduate Coordinating Committees:
Fuhr, J. E., Ph.D., Medical Biology
Lawler, J. E., Ph.D., Psychology
Lozzio, C., M.D., Medical Biology
Potgieter, L. N. D., Ph.D., Veterinary Teaching Hospital

The Comparative and Experimental Medicine degree program (M.S. and Ph.D.) is a jointly-administered graduate program intended to prepare students for teaching and/or research careers in the health sciences. This program emphasizes the comparative approach to the study of pathology, immunopathology, aberrant metabolism, oncology, and genetic disorders. The Ph.D. program is open to approved graduate students seeking training in this area and is especially useful for individuals with professional degrees. For the student with an undergraduate biological science background, the Comparative and Experimental Medicine program provides an unusual opportunity to study disease processes common in humans and animals from a multidisciplinary perspective. The scope of this intercollegiate program, which pools faculty resources from both veterinary and human medicine, is broadened by faculty members representing animal science and numerous areas of the life sciences. The interdisciplinary training environment includes such diverse support as facilities and personnel at the Veterinary Teaching Hospital, the Oak Ridge National Laboratory, Knoxville Zoological Park, Hemophilia Clinic, Birth Defect Center, Aberrant Metabolism Laboratory, and Hematology and Oncology services. For specific course listings, see Veterinary Medicine and Medical Biology under Fields of Instruction.

ADMISSION REQUIREMENTS

General Requirements
Admission requirements of The Graduate School of UT Knoxville will apply. In addition, all applicants will be required to furnish three letters of recommendation from individuals who are familiar with their scholastic or professional records.

Requirements for Admission to the Master of Science Degree Program
Applicants will be required to have a professional degree in one of the medical sciences (M.D., D.D.S., D.V.M.) or a baccalaureate degree with coursework including chemistry through organic; mathematics through calculus; one year of physics; and one year of basic biology plus an additional half-year of more advanced study in the field of biology including courses such as biochemistry, mammalian anatomy, histology, cell biology, or others that are appropriate for individuals aspiring to research careers in biomedical science.

Applicants for admission to the Master of Science program whose backgrounds include no formal training in the biomedical field beyond the baccalaureate degree will be required to present evidence of satisfactory performance on the Graduate Record Examination.

Requirements for Admission to the Doctor of Philosophy Program
Applicants will generally be expected to have a Master's degree in one of the biological sciences or a professional degree in one of the medical sciences.

Selected individuals having baccalaureate degrees with strong backgrounds in the physical and biological sciences may be admitted upon presenting evidence of satisfactory performance on the Graduate Record Examination.

Exceptions to the above requirements may be made at the discretion of the Admissions Committee if the minimal requirements of The Graduate School have been met. Applicants who are admitted to graduate programs but who are lacking in course requirements will be required to correct these deficiencies early in their graduate programs.

For additional information, write to the Office of Research and Graduate Programs, P.O. Box 1071, Knoxville, TN 37901.

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 Ph.D. programs in Comparative and Experimental Medicine are available to residents of the state of Kentucky. Additional information may be obtained from the Residency Assistant in the Office of Graduate Admissions and Records.

Computer Science

(College of Liberal Arts)

MAJOR DEGREES

Computer Science .............. M.S., Ph.D.
Jesse H. Poore, Head

Professors:
Ali, Moonis (UTSI), Ph.D. ............. Aligarh
Ali, Moonis (UTSI), Ph.D. ............. Aligarh
Ali, Moonis (UTSI), Ph.D. ............. Aligarh
Bhattacharya, Jack, Ph.D. ............. New Mexico
Bhattacharya, Jack, Ph.D. ............. New Mexico
Gonzalez, R. C., Ph.D. ............... Florida
Gonzalez, R. C., Ph.D. ............... Florida
Poon, J. H., Ph.D. .................. Georgia Tech
Sherman, Gordon, Ph.D. ............. Purdue
Thomson, Michael G., Ph.D. ........ Duke

Associate Professors:
Case, Jeffrey D., Ph.D. .............. Illinois
Case, Jeffrey D., Ph.D. .............. Illinois
Char, Bruce W., Ph.D. .............. California
Char, Bruce W., Ph.D. .............. California
Langston, Michael A., Ph.D. ........ Texas A&M
MacLennan, Bruce J., Ph.D. .......... Purdue
MacLennan, Bruce J., Ph.D. .......... Purdue
Pfleeger, Charles P., Ph.D. .......... Penn State
Pfleeger, Charles P., Ph.D. .......... Penn State
Whitehead, Bruce (UTSI), Ph.D. .... Michigan

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Assistant Professors:
Blair, J. R. S., Ph.D. ........................................ Pittsburgh
Lee, See (UTK), Ph.D. ......................................... Florida
Mutchler, David, Ph.D ........................................ Duke
Straight, David W., Ph.D ....................................... Texas
Vose, M. D., Ph.D ........................................... Texas
Zemankova, M., Ph.D ................................. Florida State

Instructor:
Mayo, J. W., M.S ........................................ Tennessee

THE MASTER'S PROGRAM

One year of college mathematics beyond algebra and trigonometry is required for admission. For the master's degree, 30 semester hours of graduate credit are required, 24 of which must be 500 level or above. 511, which is required for admission, cannot be counted toward the 30 semester hours, is available to students who need a stronger background in mathematics; one course in programming in a modern recursive, high-level language is the prerequisite to 0 or 511. Graduate course requirements in the department are allowed but must be approved by the Graduate Committee before enrollment.

Thesis Option
The student must reach agreement on a thesis topic with a faculty advisor and must take 6 hours of 500 Thesis. Six hours of 500 Thesis may count in the 24-hour requirement at the 500 level or above.

Non-Thesis Option
The student must take coursework in an area to prepare for the non-thesis Master's examination. The student's advisor must verify that an acceptable set of courses has been taken before the student may schedule the examination. Information concerning the examination is available in the department office.

Master's Minor in Computer Science
The graduate minor consists of 511 or its equivalent plus an additional 6 hours of computer science graduate level courses at or above the 400 level.

THE DOCTORAL PROGRAM

A student seeking admission to the Ph.D. program is expected to meet the following requirements:
1. The student should have three letters of recommendation sent directly to the department head from individuals capable of assessing the student's potential for advanced work in computer science (for example, college teachers or employers for whom the student has worked after earning a Bachelor's degree). The department reserves the right to contact these individuals or other knowledgeable people if additional information is deemed necessary or desirable.
2. The student is expected to have taken the GRE verbal and quantitative general test within the past three years and to have these scores sent to The Graduate School.
3. The student should satisfy the same background requirements as for the Master's program. See the departmental brochure for details.

Original research reported in a dissertation of high quality is emphasized. The minimum hour requirements are 24 hours of course 600 (Doctoral Research and Dissertation) and 24 hours of graduate courses beyond the equivalent of a Master's degree (beyond 30 graduate credit hours) graded A-F. The 24 hours of courses must include at least six semester hours of 600-level courses taken in computer science at UT Knoxville. The student's advisor and committee will establish the specific course requirements. The comprehensive examination consists of a departmental written examination and a subsequent oral examination conducted by the student's committee.

GRADUATE COURSES

401 Applications of Computer Graphics (3) Commercial software, techniques, hardware. Prereq: 100 or 101 or 102. Not for credit for computer science majors. 3 hr lab required.
402 Applications of Artificial Intelligence (3) Commercial software, techniques, hardware Prereq: 100 or 101 or 102. Not for credit for computer science majors. 3 hr lab required.
403 Applications of Microcomputers (3) Microcomputers, DOS, commercial software and hardware. Prereq: 100 or 101 or 102. Not for credit for computer science majors. 3 hr lab required.
404 Applications of Database Systems (3) Commercial software and systems, techniques. Prereq: 100 or 101 or 102. Not for credit for computer science majors. 3 hr lab required.
421 Introduction to Artificial Intelligence (3) Basic techniques of heuristic search, gaming, and theorem proving. Prereq: 320. 3 hr lab required.
422 Expert Systems (3) Production rule model and its extension into many-valued and fuzzy logics. Deriving explanations, examples of expert system tools and building expert systems. Other methodologies--frames, scripts, decision expressions. Prereq: 421. 3 hr lab required.
423 Natural Language Processing (3) Phrase-structured and slot grammars, error-correcting interfaces and semantics. Applications in database and expert systems. Prereq: 381 and 421.
424 Robotics Software (3) Software for robotic control. Prereq: 331 and Mathematics 142. 3 hr lab required.
425 Functional Languages (3) Functional, applicative and object-oriented languages, LISP and SMALLTALK, used for research applications. Prereq: 111, 112 and 142. 3 hr lab required.
432 Computer Graphics (3) Interactive computer graphics. Transformations, perspectives, shading, vector generation. Graphics hardware, tablets and chips, with goal of understanding techniques for designing computer systems for graphics capability. Prereq: 331. 3 hr lab required.
434 Networks and Communications (3) ISO open system interconnection model, protocols, study of several existing wide area networks, local area networks. Prereq: 331 and 360.
435 Microcomputer Systems (3) Disk operating systems, peripherals, local area networks and communication protocols. Introduction to multiprocessor microcomputer systems. Prereq: 331 and 360. 3 hr lab required.
436 Computer Systems Hardware Design (3) Computer systems hardware: bus structures, I/O devices, interrupt support software, direct memory access logic, timing budgets, and system considerations. Lab: construction, testing and debugging of either or both of packaged subsystems, all based on commercially available microcomputer component devices. Prereq: 435.
439 Microprogramming (3) Microprogramming concepts and techniques for control systems of large and small machines. Bit-slice architecture, sequencers. Prereq: 331. 3 hr lab required.
441 Science Information Systems (3) Design of scientific data banks, document retrievals, information retrieval and electronic dissemination services. Control and dissemination of scientific information at national and international level. Prereq: 340.
442 Introduction to Database Management Systems (3) File searching and organization, hierarchical, network, and relational models; relational calculus and algebra, database and query languages; implementation and security considerations; performance, integrity, and reliability metrics; intelligent database systems. Prereq: 340 and 311.
451 Pattern Recognition and Analysis (3) Elements of syntactic pattern recognition, learning algorithms, decision theory, classification rules. Prereq: 111, 112 and 311. 3 hr lab required.
452 Image Processing and Analysis (3) Methods for digitizing, storing, processing, and displaying images. Image enhancement, restoration. Prereq: 451. 3 hr lab required.
460 Human Factors in Software (3) Interface between people and machines and use of software in intended environment. Prereq: 111 and 112.
462 Software Engineering (3) Exploration of software design and application process from initial requirement and specification statements to coding, testing, implementation, and maintenance. Prereq: 111 and 112.
463 Programming Languages (3) Study and comparison of programming languages and their environments. Application, paradigms, semantics, political issues. Prereq: 111 and 112.
465 Parallel Computation I (3) Examination of non-numerical algorithms for parallel computation, operating systems, design and classification of parallel processors, computer architecture. Prereq: 433.
471 Numerical Analysis (3) (Same as Mathematics 471.)
472 Numerical Algebra (3) (Same as Mathematics 472.)
482 Graph Theory and Applications (3) Planarity, network flow, critical paths. Prereq: 111, 112 and 311.
494 Special Topics in Computer Science (1-3) May be repeated. Maximum 9 hrs.

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 in which student uses University facilities and for whom faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/N/C only.

511 Immigration to Computer Science (5) Advanced programming techniques in high-level language; control of input/output devices; file systems; machine organization and assembly language programming; data structures and analysis of algorithms. Computing laboratory. Prereq: Course in programming.

521 Artificial Intelligence (3) Heuristic search, automatic theorem proving, symbolic methods, semantic information processing, representation theory. Prereq: 511 and 513.

522 Cybernetics (3) Various functions in living systems and their actual or potential realization in computers. Prereq: 511 and 513.

525 Machine Learning (3) Algorithms whereby computers exhibit aspects of learning or inference about their environment. Supervised and unsupervised methods; decision, pattern analysis, explicit and implicit structures. Prereq: 521.

525 Software Engineering (3) Survey of key ideas in software engineering; formal methods, tools, testing, reliability—structured design and development, metrics, management and history of the field.


535 Computer Architecture (3) Parallel processing control methods, pipeline, vector processors, functional units, memory organization and control, data flow, reduced instruction sets, symbolic processors. Prereq: 511 and 513.


538 Computer Networks (3) Design and operation of networks. Hardware and software systems; communications subsystems. Prereq: 511 and 513.


544 Information Storage and Retrieval (3) Organization, storage and retrieval of bibliographic data; analysis of commercial I/R system; information analysis and retrieval—dictionary and thesaurus construction; statistical and syntactic approaches to content analysis. Prereq: 511.

551 Pattern Analysis (3) Decision-theoretic and structured pattern analysis. Deterministic and statistical decision rules, feature extraction and representation; syntactic and semantic methods, relational models. Prereq: 513 and course in probability or statistics.

552 Image Analysis (3) Techniques of computer image processing and understanding. Prereq: 551.

562 Language Design (3) Description, structure, and design philosophies of high-level languages. Names, types, control and data structures, abstraction and modularity. Design project. Prereq: 511.


571-72 Numerical Mathematics (3) (Same as Mathematics 571-72.)

573 Finite Difference Methods for Partial Differential Equations (3) (Same as Mathematics 573.)

574 Finite Element Methods (3) (Same as Mathematics 574.)

575 Matrix Theory and Techniques in Numerical Analysis (3) (Same as Mathematics 575.)

581 Design and Analysis of Algorithms (3) Analysis of algorithms and relevance of analysis to design of efficient computer algorithms. Sorting, searching, graph algorithms, pattern matching, dynamic programming, efficient approximation algorithms.


593 Independent Study (1-15) Maximum 6 hrs toward degree requirements.

594 Special Topics in Computer Science (1-3) May be repeated. Maximum 6 hrs.

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

620 Advanced Topics in Intelligent Systems (1-6) Prereq: Consent of instructor. May be repeated with consent of department.

630 Advanced Topics in Computer Systems (1-6) Prereq: Consent of instructor. May be repeated with consent of department.

640 Advanced Topics in Databases/Information Retrieval (1-6) Prereq: Consent of instructor. May be repeated with consent of department.

650 Advanced Topics in Pattern/Image Analysis (1-6) Prereq: Consent of instructor. May be repeated with consent of department.

660 Advanced Topics in Software Systems (1-6) Prereq: Consent of instructor. May be repeated with consent of department.

670 Advanced Topics in Numerical Mathematics (1-6) Prereq: Consent of instructor. May be repeated with consent of department.

680 Advanced Topics in Theory and Foundations (1-6) Prereq: Consent of instructor. May be repeated with consent of department.

690 Advanced Topics in Computer Science (1-6) Prereq: Consent of instructor. May be repeated with consent of department.

Curriculum and Instruction

(College of Education)

MAJOR

DEGREES

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

Theodore W. Hipple, Head

Professors:

Alexander, J. E., Ed.D. ............... Kentucky
Allison, C. B., Ph.D. ................... Oklahoma
Bellon, Jerry J., Ed.D. ............... California
Blairk, Kermit J., Ph.D. ............... Ohio State
Christensen, Mark A., Ph.D. .... Kansas
Davis, A. R., Ph.D. .................... Ohio State
Dessart, Donald J., Ph.D. .......... Maryland
Doak, E. Dale, Ed.D. ................. Colorado
Francis, Henry, Ph.D. ............... Illinois

French, R. L., Ph.D. ................. Ohio State
Hipple, Theodore W., Ph.D. ......... Illinois
Howard, R., Ph.D. ..................... Ohio State
Huff, F., Ph.D. ......................... Ohio State
Jost, Karl J., Ed.D. ................. Oklahoma
Knight, Lester N., Ph.D. ........... Texas
Malik, Anand, Ed.D. ............... Columbia
Mays, N., Ph.D. ....................... Southern Illinois
McIntyre, Lonnie D., Ed.D. .... Indiana
Myer, M. E., Ph.D. ................... Florida
Ray, John R., Ed.D. ................. Tennessee
Roeseke, G. E., Ph.D. ............... Ohio State
Rowell, C. Glennon, Ed.D. .... George Peabody
Sawlon, W. S., Ed.D. ............... Virginia
Terwilliger, Paul N., Ed.D. .... Penn State
Thurman, Robert S., Ed.D. ...... George Peabody
Turner, T. N., Ed.D. ............... Penn State
Winiweski, Richard, Ed.D. .... Wayne State

Associate Professors:

Cagle, Lynn C., Ed.D. .............. Georgia
Chance, Charles A., Ph.D. .... Ohio State
Grant, A. D., Ph.D. .................. Wisconsin
Heathington, Betty S., Ed.D. ..... Tennessee
Hodge, R. L., Ph.D. ................. Texas
Ryan, Thomas K., Ed.D. .......... Ball State
Wiley, Patricia D., Ed.D. ......... Houston
Wright, J., Ph.D. ..................... North Carolina

Assistant Professors:

Austin, R. A., Ph.D. ............... Florida State
Bennett, Kathleen, Ed.D. .... Cincinnati
Hatch, J. Amos, Ph.D. ........... Florida
Hendricks, D. A., Ph.D. .......... Alabama

Graduate programs are designed to improve scholarship and educational competence in a number of areas leading to the Master of Science, the Specialist in Education, the Doctor of Education, and the Doctor of Philosophy with a major in Education.

THE MASTER'S PROGRAM

For the Master of Science, thesis and non-thesis options are available in the Curriculum and Instruction major with concentration in the following areas: curriculum, elementary education, English education, foreign language education, instructional media and technology, mathematics education, reading education, science education, and social science education. The non-thesis option requires the completion of 33 semester hours of coursework. The thesis option requires the completion of 30 semester hours including six hours of Thesis 500.

THE SPECIALIST PROGRAM

The Educational Specialist degree program with a major in Curriculum and Instruction encompasses concentrations in the following areas: curriculum, elementary education, English education, foreign language education, instructional media and technology, mathematics education, reading education, science education, social science education.

THE DOCTORAL PROGRAM

The Ed.D. program in Curriculum and Instruction may include concentration upon the following fields: curriculum, social foundations, educational research, elementary education,
English education, foreign language education, mathematics education, science education, social science education.

The Doctor of Philosophy with a major in Education includes concentrations and specializations as listed under Education.

For further information, write the Department of Curriculum and Instruction.

ACADEMIC COMMON MARKET

An agreement among southern states for sharing graduate programs allows legal residents of some states to enroll in programs at UT Knoxville on an in-state tuition basis. The M.S. program (concentration in foreign language education only) in Curriculum and Instruction is available to residents of the state of Louisiana. Information may be obtained from the Residency Assistant in the Office of Graduate Admissions and Records.

GRADUATE COURSES

404 Problems in Improvement of Instruction (1-3) Special conferences, workshops, or in-service programs. Prereq: 5 hrs. F,Sp

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

429 Language Arts/Reading Instruction in Elementary and Middle Schools (3) Language and language development as applied to teaching of oracy (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 (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

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

443 Elementary and Middle School Mathematics Instruction (3) Prerequisites for helping children learn mathematics. Unit planning, daily planning, grouping, general factors related to classroom management. Not open to students with recent course in teaching of elementary school mathematics. Cannot apply toward M.S. degree. Prereq: Admission to teacher education. F,Sp

445 Early Childhood Education: Program Development and Teaching in Kindergarten (3) Curriculum planning, classroom organization and management practices for teaching young children; relationship of kindergartners to total elementary school. Prereq: Admission to teacher education. E

451 Education in Cultural Perspective (3) Contribution of anthropological concepts (primarily concepts of culture) to understanding of education processes, problems, and thought in our society and others.

454 Teaching Strategies and Issues in Social Studies Education (3) Goals, objectives, techniques, materials, and evaluation; directed observation in public schools, preparation of teaching plans and materials; simulated teaching experiences. Prereq: Admission to Teacher Education Program.

456 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 or near completion of foreign language hours for certification and Admission to Teacher Education Program.

459 Teaching English in the Secondary School (3) Techniques in teaching language, 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. Sp

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. E

475 Utilization of Instructional Media (3) Basic concepts of communication and instructional development for improving instruction through use of media. (Same as Library and Information Science 475.) E

486 Teaching Mathematics, Grades 7-12 (3) Preparation of teaching plans, evaluation, materials for teaching mathematics; teaching simulation and directed observation in schools. Prereq: Admission to Teacher Education Program.

486 Introduction to Instructional Computing (3) Classroom uses of computers, applications for teachers, overview of computer operation and software for teachers of all grades. F,Sp

496 Teaching Science Grades 7-12 (3) Methods, materials, recent trends in science and environmental education programs in schools. Prereq: Admission to teacher education. F,Sp

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

502 Registration for Use of Facilities (3-15) Required for use of all University facilities. Prereq: Admission to Teacher Education Program. E

503 Problems in Lieu of Thesis (2-3) May be repeated. Maximum 3 hrs. F,Sp

504 Studies and Theory in Language Development (3) Studies and theory of language development in children. Prereq: 1 elementary school language arts course or consent of instructor. F

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. F

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

509 Teaching Fiction in the Secondary School (3) Teaching techniques, skill development and assessment procedures. Prereq: Admission to teacher education. F

510 Developing Reading Skills in Content Fields (3) Approaches for teaching basic reading skills and ways of teaching literature. Sp


515 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 or letter grade. E

517 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 or letter grade. E

518 Educational Specialist Research and Thesis (2) Prereq: Admission to Teacher Education Program. E

519 Educational Specialist Research and Thesis (2) P/NC only. E

520 Techniques of Research in Education (3) Study and application.

521 Teaching Social Studies in Elementary and Middle Schools (3) Planning and techniques; Trends in curriculum, development of concepts and generalizations, integration of social sciences. Prereq: Course in teaching of social studies or consent of instructor. Sp

522 Teaching Mathematics in Elementary and Middle Schools (3) Instructional strategies for helping elementary school children learn mathematics. Examination, development and use of materials for creating active learning environment. Prereq: 443 or equivalent or consent of instructor. F,Sp

523 Diagnosis and Correction of Children's Difficulties in Learning Mathematics (3) Children's difficulties in learning mathematics; development of classroom teacher correct difficulties. Prereq: 522 or equivalent or consent of instructor. Sp


525 Strategies, Programs and Materials for Teaching Elementary Social Studies (3) Analysis of new and innovative social studies program materials and techniques, Exploration of current trends in social studies education. Prereq: Previous course in teaching of social studies or consent of instructor. Sp

526 Philosophy of Education (3) Truth, knowledge, and valuation in relation to work of schools. F,Sp

527 Elementary School Curriculum (3) Examination, evaluation and application of curriculum designs in elementary school. Trends and issues which affect elementary education. Prereq: Consent of instructor. F,Sp

528 Teaching Language Arts Elementary and Middle Schools (3) Recent trends and current materials and methods in teaching elementary language arts (except reading). Prereq: Course in language arts or consent of instructor. F,Sp

529 Practicum in Diagnosis and Remediation of Difficulties in Learning Mathematics (2) Assessment and practicum experience with children having difficulties in learning elementary school mathematics. Prereq: 523 or consent of instructor. May be repeated. Maximum 4 hrs. Su

530 Teaching Reading in Elementary and Middle Schools (3) Trends in methods, materials, basic approaches, skill development and assessment procedures for teaching reading at elementary school level. Prereq: Course in teaching of reading or consent of instructor. F,Sp

531 Teaching Science in Elementary and Middle Schools (3) Recent trends in methods, materials and content in teaching elementary school science. Prereq: Course in teaching elementary school science or consent of instructor. F

532 Instructional Research: Analysis and Application (3) Analysis of research on instruction. Translation and application of research to instructional practice. Prereq: Consent of instructor. F,Sp

533 Reading in Middle and Secondary Schools: Research and Theory (3) Analysis of components of effective middle and secondary school reading programs. Attention to research and theoretical bases. Prereq: Course in reading education or consent of instructor. F,Sp

534 Seminar in Reading Education (1-6) May be repeated. Maximum 6 hrs. F

535 Curriculum Evaluation and Program Improvement (3) Historical background and importance of educational evaluation in relation to curriculum development. Understanding systematic curriculum evaluation approach and applying it to improve program development and implementation. Prereq: Consent of instructor. E

536 Psychology of Reading (3) Reading act, relation of child's learning and reading, role of reading in child's overall intellectual development. Affective and cultural factors. Prereq: 500-level course in reading education or consent of instructor. F

537 Diagnosis and Correction of Classroom Reading Problems (3) Procedures, methodologies and materials for diagnosing and correcting classroom reading problems. Prereq: Course in reading or equivalent reading experience, or equivalent teaching experience, or consent of instructor. Sp,Su

538 Practicum in Diagnosis of Reading Problems (2) Theoretical and practical applications of specific reading diagnostic instruments; testing of elementary and/or secondary school students, preparing case study reports, and conducting parent conferences. Prereq:
556 Programs, Materials and Strategies in Teaching Elementary Science (3) Analysis of new and innovative science program materials. Instructional strategies and current curriculum issues inherent in use of materials. Prereq: Graduate course in elementary science, at least one year teaching experience, or consent of instructor. Sp
556 Administering Instructional Media Programs (3) Leadership roles and responsibilities of professional media administrator in variety of organizational settings. F
557 Application of Theory in Early Childhood Education (K-3) (3) Principles and practices from selected theoretical orientations. Prereq: Course in early childhood education or consent of instructor. May be repeated. Maximum 6 hrs. Fu
558 Teacher-Parent-Community Relations (3) Techniques for effective relations between parents and teachers: examination of roles and expectations; parental involvement; volunteer programs; influence of community on educational process. Prereq: Consent of instructor. Sp/Fu
559 Advanced Production of Audiovisual Software (3) Hand and mechanical lettering, flipchart mounting-laminating, overhead projection, audio production, TV studio operation, sync-taping, multi-screen presentations, and print and technical byline as Library and Information Science 569, Sp/Fu
560 Curriculum Planning and Development (3) Principles and practices from selected theoretical models related to how learners process print. Prereq: At least one language arts course or consent of instructor. Su
562 Developmental Reading Practicum (2) Diagnostic and corrective reading developmental and corrective reading needs. Prereq: Course in diagnosis and correction of reading problems or consent of instructor. May be repeated. Maximum 4 hrs. Su
563 Assessment and Correction of Language Arts Difficulties (3) Procedures and materials for diagnosing and correcting language arts difficulties; analysis of children's work. Prereq: At least one language arts course or consent of instructor. Su
565 Teaching of Natural Science and Environmental Education (3) Advanced instructional techniques and investigative procedures to diagnose English linguistic proficiency; materials for non-native speakers of English. Prereq: 581. Su
568 Teacher-Parent-Community Relations (3) Techniques for effective relations between parents and teachers: examination of roles and expectations, parental involvement; volunteer programs; influence of community on educational process. Prereq: Consent of instructor. Sp/Fu
569 Teaching English as a Second Language (3) Instructional techniques, methodology, applications from microcomputers to supercomputers. Prereq: Consent of instructor. F
570 Teaching English as a Second Language (3) Instructional techniques, methodology, applications from microcomputers to supercomputers. Prereq: Consent of instructor. F
573 Utilization of Educational Television and Radio (3) Television and radio as instructional and training media. Selection and evaluating Instructional training video and audio tapes. F
574 Survey in Contemporary Philosophies of Education (3) Existentialism, phenomenology, philosophical analysis. Marxism, structuralism, hermeneutics and other philosophies. F
575 Educational Sociology (3) Sociological analysis of American education system. Controversial social issues that affect educational system and potential solutions offered by various programs. Open to juniors, seniors, and graduate students. F
576 Topics in History of Education (3) May be repeated. E
577 Topics in Philosophy of Education (3) May be repeated. F/Su
578 Topics in International Education (3) Historical, philosophical, and sociological foundations; selected nations and their cultures. May be repeated. E
579 Assessment and Correction of Language Arts Difficulties (3) Procedures and materials for diagnosing and correcting language arts difficulties; analysis of children's work. Prereq: At least one language arts course or consent of instructor. Fu
580 Techniques for Research in Curriculum and Instruction (3) Fundamentals of research methodology applicable to curriculum, instruction, and other areas of educational inquiry. Critical reading of research and development of skills needed for proposal development. F
581 Seminar in Mathematics Education (3) Current issues influencing instruction in mathematics in schools, elementary through college. Related teaching methodologies, Critical review of special problems. Prereq: Undergraduate course in teaching of mathematics. Su
582 Teaching Enrichment Mathematics in Middle and Junior High Schools (3) Topics to enrich middle and/or junior high mathematics. Geometrical, laboratory, and problem solving activities. Special attention to metric system. Opportunities for individual projects. Prereq: 581. Su
583 Teaching Mathematics in Senior High Schools and Community Colleges (3) Topics appropriate for high school and community/junior college mathematics curriculum. Special problems related to enrichment, problem solving, and use of microcomputers. Opportunities for individual projects. Prereq: 581. F/Su
585 Teaching Secondary School Social Studies (3) Strategies, projects, materials, and programs in social studies. Prereq: Undergraduate course in teaching of social studies. F/Su
586 Teaching Probability & Statistics (3) Teaching of probability and statistics in schools, elementary through college. Probabilistic and statistical experiments, demonstration, and applications. Prereq: 581. F
587 Teaching Foreign Languages in Secondary Schools (3) Advanced instructional techniques and evaluation procedures: materials analysis and preparation; tests, issues, and research in modern foreign languages and Latin. Prereq: Consent of instructor.
588 Instructional Theory and Design (3) Relationship of curriculum to instruction; examination of instructional and related learning theories; instructional models and teaching styles. E
589 Field Experience (1-3) Application of curriculum and instructional principles, methods, and materials in schools. Prereq: Program prerequisites and consent of instructor. May be repeated. Maximum 9 hrs. S/N only. E
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. F
593 Independent Study (1-3) May be repeated. S/N or letter grade. E
594 Supervised Readings (1-3) May be repeated. S/N or letter grade. E
595 Special Topics (1-3) May be repeated. S/N or letter grade. E
596 Teaching of Natural Science and Environmental Education (3) Strategies, laboratory techniques, assessment, current programs and professional guidelines for middle, junior and senior high schools, and community colleges. Prereq: Consent of instructor. F
597 Teaching Drama Grades 7-13 (3) Strategies and materials for teaching creative dramatics, enacting and writing of plays, reading of scripts. Sp
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. F
599 Seminar in Social Studies Education (3) Research, trends, and issues in secondary social studies. Su
600 Doctoral Research and Dissertation (3-15) P/NP only. E
601 Studies in English Education (3) Issues and research in teaching of English. Su
602 Seminar in Reading Education (1-6) May be repeated. Maximum 6 hrs. E
603 Advanced Studies and Theoretical Models of Reading (3) Research on reading processes. Current theoretical models related to how learners process print. Prereq: 500-level courses in reading education or consent of instructor. Su
604 Seminar in Curriculum and Instruction (1) Required 2 consecutive semesters. S/N 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. Su
606 Research in Elementary Education (3) Analysis of research in elementary education with application to classroom teaching. Prereq: research course. Su
608 Seminar in Philosophy of Education (3) Selected philosophical issues in education. Prereq: 2 courses in history or philosophy of education. May be repeated with consent of instructor. E
621 Seminar in Social Studies Research and Theory (2) Status of research and theory. Needed research, relation of research from other fields, and application of research. Prereq: Recent course in teaching of social studies or consent of instructor. Su
623 Programs for Curriculum Improvement (3) Research methodology: application to descriptive ethnographic curriculum materials. Critical reading of research, methodology, and development in descriptive and ethnographic areas. Sp
625 Seminar in History of Education (3) Selected historical issues in education. Prereq: 2 courses in history or philosophy of education. May be repeated with consent of instructor. Sp

628 Advanced Studies in Elementary School Science (2) Current research in elementary school science as part of a comprehensive program. Prereq: Graduate course in science education or equivalent or consent of instructor. May be repeated. Maximum 4 hrs. E

635 Teacher Education in America (3) For students preparing to enter teacher education. Brief historical development, program analysis and evaluation, current issues, and future directions. F

640 The Dynamics of Educational Change (3) Interdisciplinary approach to change process in education. Prereq: Consent of instructor. Sp

648 Topics in Sociology of Education (3) May be repeated. Sp

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

651 Advanced Studies in Elementary School Language Arts (3) Selected issues in elementary school language arts. Prereq: Graduate course in elementary school language arts. Consent of instructor or consent of instructor. Sp

652 Advanced Studies in Educational Anthropology and/or Sociology (3) Ethnographic methods applied to formal and non-formal educational settings. Analysis of selected research in field. Prereq: 451. 2 courses in cultural anthropology, or consent of instructor. Sp

669 Instructional Media Research (3) Identification, location, collection, and development of educational and experimental research on instructional media. Application of research. Sp

571 Advanced Educational Statistics (3) Applications of parametric and non-parametric statistical inference to educational and instructional problems. Use of microcomputers in educational research. Prereq: 561. Sp, Su

672 Interpretation and Application Curriculum and Instruction Research (3) Analysis of research in curriculum and instruction, newer methodologies and strategies. Utilization of research to improve curriculum and instruction practice, application of research principles in context of specific professional assignments. Prereq: Consent of instructor. Sp


676 Curriculum Theory (3) Influential curriculum theories and approaches, implications for structure and design of educational programs. Nature and function of theoretical building activities. Prereq: Consent of instructor. E

683 Advanced Studies in Elementary School Mathematics (2) Research in elementary school mathematics. Prereq: Graduate course in mathematics education or consent of instructor. Sp

685 Educational Leadership: Theory and Practice (3) Theories of leadership applied to variety of educational settings. Prereq: Consent of instructor. F, Su

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 or letter grade. E

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

694 Supervised Readings (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

696 Advanced Studies in Secondary School and Environmental Education (3) Trends in science and environmental programs, materials methods and research for middle, junior and senior high schools, and community recreation. Prereq: 596 or equivalent and consent of instructor. Sp

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**Ecology (College of Liberal Arts)**

**MAJOR DEGREES**

| Ecology | M.S., Ph.D. |

Dewey L. Bunting, Director
J. Larry Wilson, Associate Director
Paul A. Decourt, Associate Director

Shared Faculty:
Amundsen, C. C., Ph.D., Botany
Bartell, Steve, Ph.D., ORNL
Blaylock, B. G., Ph.D., ORNL
Boake, Christine R. B., Ph.D., Zoology
Buckner, E. R., Ph.D., Forestry, Wildlife & Fisheries
Bunting, Dewey L., Ph.D., Zoology
Burghardt, G. M., Ph.D., Psychology
Carter, James R., Ph.D., Geography
Clebsch, E. E. C., Ph.D., Botany
Courant, C. C., Ph.D., ORNL
DeAngelis, D. L., Ph.D., ORNL
Deardens, B. L., Ph.D., Forestry, Wildlife & Fisheries
Delcourt, Hazel, Ph.D., Geology
Delcourt, Paul A., Ph.D., Geology
Dimmick, Ralph W., Ph.D., Forestry, Wildlife & Fisheries
Drake, James A., Ph.D., Zoology
Eckert, N. H. D., Ph.D., Zoology
Ewold, J. W., Ph.D., ORNL
Etter, D. A., Ph.D., Zoology
Evans, A. M., Ph.D., Botany
Farkas, Walter, Ph.D., Environmental Practice
Furburg, Henry A., Ph.D., Plant & Soil Science
Gardner, R. H., Ph.D., ORNL
Geoh, C. W., Ph.D., ORNL
Gist, C. S., Ph.D., OARU
Gittleman, John L., Ph.D., Zoology
Goss, L. Barry, Ph.D., Science Appl.
Greenburg, Neil, Ph.D., Zoology
Gross, L. J. D., Mathematics
Hallam, Thomas G., Ph.D., Mathematics
Hammitt, W. E., Ph.D., Forestry, Wildlife & Fisheries
Hansen, J. H., Ph.D., UTSI
Hardin, Carol P., Ph.D., Geography
Hay, R. L., Ph.D., Forestry, Wildlife & Fisheries
Herbes, S. E., Ph.D., ORNL
Hildebrand, S. G., Ph.D., ORNL
Hilty, J. W., Ph.D., Entomology & Plant Pathology
Hon, Sally M., Ph.D., Geography
Houston, M., Ph.D., ORNL
Kelly, J. M., Ph.D., TVA
Kimmel, B. L., Ph.D., ORNL
McCarthy, J. F., Ph.D., ORNL
McCormick, J. Frank, Ph.D., Botany
McCracken, G. F., Ph.D., Zoology
McKinney, M. L., Ph.D., Geology
McLaughlin, S. B., Ph.D., ORNL
Mulholland, P. J., Ph.D., ORNL
Nodvin, Sarah C., Ph.D., CPSU
Olson, J. S., Ph.D., ORNL
O'Neil, R. V., Ph.D., ORNL
Pagni, R. M., Ph.D., Chemistry
Pelton, Michael R., Ph.D., Forestry, Wildlife & Fisheries
Pimm, S. L., Ph.D., Zoology
Pless, C. D., Ph.D., Entomology & Plant Pathology
Post, W. D., Ph.D., ORNL
Reed, R. M., Ph.D., ORNL
Rehder, J. B., Ph.D., Geography
Reichle, D. E., Ph.D., ORNL
Renjie, J. C., Ph.D., Forestry, Wildlife & Fisheries
Reynolds, John H., Ph.D., Plant & Soil Science
Riechert, Susan E., Ph.D., Zoology
Saylor, Gary S., Ph.D., Microbiology
Schrobaum, S. E., Ph.D., Forestry, Wildlife & Fisheries
Smith, W. O., Ph.D., Botany
Stacey, G., Ph.D., Microbiology
Stewart, A., Ph.D., ORNL
Strange, R. J., Ph.D., Forestry, Wildlife & Fisheries
Van Hook, R. I., Ph.D., ORNL
Van Winkle, W., Ph.D., ORNL
Vaughn, G., Ph.D., Zoology
Walton, B. T., Ph.D., ORNL
Wehry, E. L., Ph.D., Chemistry
West, D. C., Ph.D., ORNL
White, David C., Ph.D., Microbiology
Wilson, J. L., Ph.D., Forestry, Wildlife & Fisheries
Witherspoon, J. P., Ph.D., ORNL
Woods, F. W., Ph.D., Forestry, Wildlife & Fisheries

The Graduate Program in Ecology offers Master of Science and Doctor of Philosophy degrees. This interdepartmental program provides advanced courses in contemporary ecology for students from undergraduate programs in basic and applied biology, social sciences, mathematics, and engineering. Research opportunities in both fundamental and applied ecology are intended to prepare students for academic careers as well as professional positions in industry or government. The Environmental Sciences Division of the Oak Ridge National Laboratory, the national Park Service, and the Tennessee Valley Authority provide advisors and research facilities. The Great Smoky Mountains, Cumberland Plateau, valley and ridge topography, TVA lakes and wild rivers provide locally a spectrum of natural habitats and consequent biological diversity that is truly unique. In addition, faculty research programs provide opportunities for student research elsewhere on this continent and abroad.

**ADMISSION REQUIREMENTS**

Requirements for admission to this program are: (1) admission to The Graduate School; (2) chemistry including organic mathematics including calculus, and 3 semester hours of ecology at the upper division level (physics highly recommended); (3) departmental application and 3 rating forms; (4) the Graduate Record Examination.

Application forms for admission should be obtained from The Graduate School and the Ecology Program. Inquiries concerning the admission requirements should be addressed to the Director, Graduate Program in Ecology, University of Tennessee, Knoxville, Tennessee 37996-1610.

**THE MASTER'S PROGRAM**

Within the minimum requirements of The Graduate School, the program of study must include Ecology 573 and 574 or an approved equivalent and one course from an approved list of quantitative methods offerings. The list is available from the ecology office and is updated.
annually by the Ecology Curriculum Committee. The remainder of a student's course program is determined in consultation with the graduate coordinator. A list of approved campus-wide ecology offerings is provided to each student during orientation.

A graduate minor in ecology is available on an individual basis.

THE DOCTORAL PROGRAM

The requirements for this degree are in general the same as those of The Graduate School. The doctoral program must include Ecology 573 and 574 or an approved equivalent and one course from an approved list of quantitative methods offerings. A student cannot enroll for dissertation hours until the research proposal at UT Knoxville on an in-state tuition basis. Enrolling graduate students should consult early with the director of the program on the choice of a faculty committee. The Master's committee need not have more than three members. Doctoral committees consist of the major professor as chairperson, one additional member who should have an appointment in the same department, and at least two additional faculty from other departments.

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 Ecology is available to residents of the state of Alabama. Additional information may be obtained from the Residency Assistant in the Office of Graduate Admissions and Records.

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 Special Problems in Ecology (1-3) Individual investigations in ecology. May be repeated with consent of instructor. Maximum 6 hrs.

530 Ecology for Planners and Engineers (3) Ecological principles and effects that human-caused changes have on living organisms. Lectures and field trips. Appropriate for students in planning and Environmental Engineering.

530 Implementation of Environmental Policy (3) Goals and problems of environmental legislation, National Environmental Policy Act; purpose, preparation, and evaluation of environmental impact statements and similar multidisciplinary studies. Prereq: 520 or 573 or course work or experience in environmental law.

537 Natural Resource Management and Environmental Assessment in Developing Nations (3) Assessment of environmental and resource development issues. Scientific basis for integrated environmental management and assessment in developing nations. Prereq: General ecology or equivalent. (Same as Planning 553 and Botany 537.)

552 Development Planning in the Third World (3) (Same as Planning 552.)

555 Environmental Planning (3) (Same as Planning 555.)

561 Environmental Toxicology (3) (Same as Biochemistry 561.)

562 Techniques in Environmental Toxicology (1) (Same as Biochemistry 562.)

573 Population Biology (3) (Same as Zoology 573 and Botany 573.)

574 Communities and Ecosystems (3) Patterns underlying principles between short and long term community and ecosystem organization, dynamics, energetics and nutrient cycling.

600 Doctoral Research and Dissertation (1-15) P/NP only. E

604 Current Topics in Environmental Toxicology (1) (Same as Biochemistry 604.)

610 Special Topics in Ecology (3) Seminars on advanced topics and recent developments. Prereq: Consent of instructor. May be repeated. Maximum 9 hrs.

620 Seminar in Ecology (2) May be repeated. Maximum 12 hrs.

637 Applied Ecology (3) Review of contemporary and historical issues. Analysis of scientific basis of environmental assessment and natural resource management. Analysis of complex and career planning in applied ecology. Prereq: 573-74 or equivalent or consent of instructor. (Same as Botany 637.)

Economics

(College of Business Administration)

MAJORS

DEGREES

Economics................................................. M.A., Ph.D. Business Administration............. MBA

Anne Mayhew, Head

Professors:

Bohn, Robert A., Ph.D. Washington (St. Louis)
Bowley, Roger L., Ph.D. .......... Texas
Carroll, Sidney L., Ph.D. .......... Harvard
Chang, Hui S., Ph.D. .......... Vanderbilt
Cole, William E., Ph.D. .......... Texas
Davidson, Paul (J. Fred Holy Chair), Ph.D. Michigan State
Feiwel, George R. (Distinguished Prof.), Ph.D. ......... McGill
Fox, William F., Ph.D. .......... Ohio State
Garrison, Charles B., Ph.D. .......... Kentucky
Herzog, Henry W., Ph.D. .......... Maryland
Jensen, Hans E., Ph.D. .......... Texas
Lee, Fung-Yao, Ph.D. .......... Michigan State
Mayhew, Anne, Ph.D. .......... Texas
Moore, John R. (Distinguished Prof.), Ph.D. .......... Cornell
Neale, Walter C., Ph.D. .......... London
Quinlan, K. E. (Emeritus), Ph.D. .......... Kentucky
Schlottman, Alan M., Ph.D. .......... Washington
Spiva, George A., Ph.D. .......... Texas

Economics Associates Professor:

Clark, Don P., Ph.D. .......... Michigan State
Glustoff, Errol, Ph.D. .......... Stanford
Mayo, John W., Ph.D. .......... Washington (St. Louis)
Phillips, Keith E., Ph.D. .......... Washington

Assistant Professors:

Gauger, Jean A., Ph.D. .......... Iowa State
Kunkin, Matthew, Ph.D. .......... Wisconsin
Mundy, David M., Ph.D. .......... Illinois
Murray, M. N., Ph.D. .......... Syracuse

The Department of Economics offers graduate programs leading to the M.A. and Ph.D. The M.A. may be completed by either a thesis or non-thesis option, while the Ph.D. requires successful completion of a dissertation. Applicants to these programs should contact the Director of Graduate Studies, Department of Economics, for further information. The Department also offers an area of concentration for the MBA degree. Students interested in the MBA program should contact the Associate Dean for Graduate Programs, College of Business Administration.

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 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 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.

THE MASTER'S PROGRAM

Admission to the M.A. program is based on undergraduate academic performance and on scores from the general portion of the GRE or on scores from the GMAT. The student may choose either the thesis or non-thesis option. Students interested in the MBA program should contact the Associate Dean for Graduate Programs, College of Business Administration.

THE DOCTORAL PROGRAM

Admission to the Ph.D. program is based on promise of outstanding scholarship as demonstrated by previous academic performance and by scores achieved on the general portion of the GRE or on the GMAT. Requirements for successful completion of the program consist of the four components listed below:

1. Students are required to complete the following core requirements:
a. Economic Theory: Microeconomic theory by comprehensive examination or by completion of 511, 512 with a B+ average or higher, and macroeconomic theory by comprehensive examination or by completion of 513, 514 with a B+ average or higher.


c. Mathematical and Quantitative Economics: 581, 582. The 582 requirement may be waived for students completing 681, 682.

Students must achieve a grade average of B or higher over the courses offered to fulfill requirements in subparagraphs b and c, or, as an alternative, may petition to satisfy either or both of these two core areas by some other means such as a comprehensive written examination.

2. Students are required to demonstrate their competence by comprehensive examination in two fields of specialization with the approval of the department, at least one of which must be selected from the following: comparative systems, economic development, economic history, economics of labor and human resources, industrial organization, international economics, money and finance, and regional and urban economics.

3. Students are required to complete with a grade of C or better two elective economics courses at the 500 level or above, outside the core subject areas and outside the two fields of specialization.

4. Students are required to complete a dissertation, including an oral defense, to give at least 24 hours of graduate credit (600).

BUSINESS ADMINISTRATION CONCENTRATION

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

MBA Concentration: Economics.

Minimum course requirements are as approved by the area MBA faculty advisor.

GRADUATE COURSES

400 Special Topics (3) Topics vary. Prereq: Determined by department.

413 Macroeconomic Fluctuations (3) Analysis of historical data, methods of analyzing macro-economic fluctuations, theoretical explanations of cycles, and role of monetary and fiscal policies in aggregate economy. Prereq: Intermediate Macroeconomics, or consent of instructor.

415 History of Economics (3) Methods of study of doctrinal history. Origins and evolution of major doctrines: classical and neoclassical economics, economics of Keynes and his followers, principal developments of second half of 20th century. Major writing requirement. Prereq: 201 or equivalent and consent of instructor.

424 Political Economy of World Development (3) Topics vary: Latin America, Asia, Soviet Union and Eastern Europe. Analysis of major economic strategies, policies, and problems. Prereq: 201. This course includes a major writing requirement. May be repeated when topic varies. Maximum 9 hrs.


462 Economics of Resources and Environmental Policy (3) Economic analysis of environmental policy and allocation of resources. Benefits and costs of development of natural resources and impacts of growth on environment. Major writing requirement. Prereq: 201.

471 Public Finance: Optimal Government Functions and Expenditure Analysis (3) Analysis of individual and collective consumption, external effects, public investment, social decision making. Prereq: 201.

472 Public Finance: Taxation and Intergovernmental Relations (3) Analysis of individual and collective consumption, external effects, public investment, social decision making. Prereq: 201.

482 Introduction to Mathematical Economics (3) Application of algebra, matrix algebra, differential and integral calculus to micro and macroeconomics. Prereq: 201 and Mathematics 121-22 or 141-42.

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

501 Managerial Economics (3) Application of economic concepts to business decision making. Analysis and forecasting of demand, cost analysis, pricing behavior, and application of optimizing techniques.

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

503 Business Conditions Analysis (3) Macroeconomic environment of firm. Determination of level of output, employment and prices for economy as whole. Implications of different macroeconomic policies. Role of forecasting techniques and stabilization policies.

510 Fundamentals of Microeconomics (3) Theory of consumer behavior and demand. theory of production and cost, behavior of the firm in perfectly competitive and monopolistic environments. Not available for students with credit for 511, Prereq: 311 or equivalent.

511-12 Microeconomic Theory (3,3) Theory of consumer choice and demand, theory of revealed preference, attributes of goods and implicit prices, market demand, labor supply, individual behavior under uncertainty, theory of firm, theory of production and cost, market structures, derived demand and factor pricing, introduction to welfare economics, market failure and theory of saving and capital accumulation. Prereq: 201 and Mathematics 121-22 or 141-42.

513-14 Macroeconomic Theory (3,3) Determination of national income, prices, and employment. Results using Keynesian, non-market-clearing, monetarist, and rational expectations paradigms.


525 Economic History of Europe (3) Nature and functioning of economic systems and policies in history of Western civilization, major issues of method and interpretation. Prereq: Graduate standing in economics or consent of instructor.

526 Economic History of the U.S. (3) Interpretation of American economic structure and policies from colonial times. Prereq: Graduate standing in economics or consent of instructor.

562 Labor Relations and Collective Bargaining (3) Same as Management 562.


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

612 Advanced Microeconomic Theory (3) Prereq: 512 or equivalent.

613 Advanced Macroeconomic Theory (3) Prereq: 502 or equivalent.


623 Economic Development: Theories and Policies (3) Principal theories explaining economic behavior in developing countries and policies and strategies used to promote development. Prereq: Undergraduate degree in economics or consent of instructor.

624 Economic Development: Western Impact on Asia and Africa (3) Studies of consequences of contact between developed world and developing countries of Asia and Africa. Prereq: Graduate standing in economics or consent of instructor.


534 Comparative Economic Systems (3) Study and appraisal of alternative economic systems in comparative perspective.

641 Labor Economics (3) Theory of labor markets and wage determination under competitive conditions. Labor markets under conditions which interfere with competition, unions and discrimination. Human capital and estimation of returns to schooling. Topics vary. Prereq: 311 and 313, or equivalent.

642 Labor History and Legislation (3) Development of organized labor as important economic and political force in U.S., from Colonial times to present. Evolution of legal status of labor unions and of individual workers vis-à-vis their employers.

515 Monetary Theory (3) Study of money, credit, and liquidity as related to real output determination, interest rates, employment, and prices. Prereq: 513.

552 Topics in Monetary Theory (3) Advanced monetary theory. Issues in modern monetary theory and policy. Student participation. Prereq: 615.

651 Regional and Urban Location and Development Theory (3) Theory of industrial and agricultural location and urban migration. Economic basic for land-use patterns, central places, and urban form. Spatial inequalities and urban problems. National policies for regional and urban assistance.

652 Methods of Regional and Urban Analysis (3) Theory of regional urban economic structure and growth. Regional income and product accounts, shift and share analysis, economic base studies, and regional urban input-output models. Theory and problem solution.


672 Public Finance: Taxation and Intergovernmental Relations (3) Taxation and public finance: political economy; public sector finance; government role. Consumer and intergovernmental relations.

681-82 Econometric Methods (3,3) Theory and techniques of statistical testing of economic hypotheses and
Theories of Curriculum Development and Foundations of Education
Specializations:
1. Anthropological, historical, philosophical, and sociological bases for educational planning and curriculum
2. Principles and models for planning, developing, and evaluating educational programs
3. School psychology
4. Elementary and early childhood instruction and practices
5. Instructional and community colleges (English, foreign language, mathematics, science, social studies education)
6. Elementary: mathematics, science, social studies education
7. Reading education
8. Instructional media and technology
9. Technological and adult education
10. Special education and rehabilitation

Theories and Practice of Educational and Personal Adjustment
Specializations:
1. Counselor education
2. Counseling psychology
3. Educational psychology
4. School psychology

Foundations of Human Movement
Specializations:
1. Exercise Science: Adapted Physical Education
2. Motor Behavior: Motor Control
3. Motor Learning
4. Psychology of Sport
5. Socio-Cultural Foundations of Sport: History, Philosophy, Sociology

Health Education
Specializations:
1. Public health
2. Safety

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 Education is available to residents of the states of Georgia or South Carolina. Additional information may be obtained from the Residency Assistant in the Office of Graduate Admissions and Records.

See College of Education for additional departmental listings.

GRADUATE COURSES
601 Trans-College Seminar (1) Introduction to Ph.D. program in Education: research requirements, meaning of scholarship in academic and personal development in education. Minimum of two consecutive semesters preceded or followed by summer term required of all Ph.D. students. Prerequisite: Admission to Ph.D. program and consent of Ph.D. program coordinator. May be repeated.

Maximum 3 hrs. May not be used to meet 600 requirement. S/NC only.

Educational and Counseling Psychology

MAJORS
- Educational Psychology
- Educational Psychology and Guidance

DEGREES
- M.S.
- Ed.D.

Professors:
- Steve McCallum, Head

Assistant Professors:
- George, Thomas, Ed.D...
- Kindall, Luther M., Ed.D...

Associate Professors:
- Harris, Shanté M., Ph.D...

The Department of Educational and Counseling Psychology offers graduate programs leading to the following: Master of Science with a major in Educational Psychology, concentrations in educational psychology and counseling; Master of Education with a major in Guidance, concentrations in community agency counseling; Master of Education with a major in Educational Psychology, concentrations in counselor education and educational psychology. The department also participates in the college-wide Ph.D. program with a major in Education. The concentration area is teacher education and practice of educational and personal adjustment with specializations in counselor education, counseling psychology, educational psychology, and school psychology.

Several programs in the department are accredited. The Ed.D. counselor education concentration is accredited by the Council for Accreditation of Counseling and Related Educa-
tional Programs; counseling psychology by the American Psychological Association; and school psychology by the National Association for School Psychology. Also, the school counseling and school psychology programs have the approval of the National Council for Accreditation of Teacher Education. The community agency counseling and guidance programs are approved by the Council for Accreditation of Counseling and Related Edu-
cational Programs.

The application deadline for admission to the doctoral programs is February 1, and to the Ed.S. and M.S. programs, February 1 and November 15. For information about the various programs of study and admissions, write the departmental admissions secretary.

THE MASTER'S PROGRAMS

Admission requirements include up-to-date scores from the GRE, the departmental ad-
misions application form and letters of rec-
ommendation. All programs include thesis and non-thesis options. The programs in educational psychology and in guidance require 36 and 42 hours, respectively, Community agency and school psychology require 30 credit hours to meet certification standards. Students should check with the department office for these requirements. The programs in community agency counseling and in guidance each require supervision of practicum and internship experi-
ences working with clients. A final examination is required of all Master's degree students.

THE EDUCATIONAL SPECIALIST

PROGRAM

Admission requirements include up-to-date scores from the GRE, the departmental ad-
misions application form and letters of rec-
nommendation. All programs include thesis and non-thesis options. The program in school psychology requires a minimum of 66 hours. When students are admitted to the Ed.S. programs in educational psychology, school counseling or community agency counseling, it is assumed that they have completed a Master's degree. In this case, the minimum hours beyond the Master's required to complete the Ed.S. are as follows: educational psychology - 24; school counseling, 22; and community agency coun-
seling, 25. The specialist programs require supervised practicum and internship experi-
ences with students or clients, either in the public schools or in community human services agencies. A final examination is required of all specialist students.

THE DOCTORAL PROGRAMS

The Ph.D. with a major in Education in-
cludes concentrations and specializations as listed under Education. For students applying to the Ph.D. program in education located in this department, two applications are required: one for the Ph.D. in Education program and one for the department that specifies which specialization is desired (i.e., counseling psychology, counselor education, educational psychology, or school psychology). Applicants for the Ed.D. with a concentration in either counselor education or educational psychology fill out only the departmental application form.

Departmental admissions requirements include up-to-date scores from the GRE; the department admissions application form; letters of recommendation; a writing sample; and, in the case of the counselor education program only, an audio or video-taped sample of the appli-
cant's counseling work with a client.

The following minimum number of hours is required in each program concentration/ specialization: counseling psychology - 98; counselor education - 99, Ed.D.- 79; educational psychology, Ph.D.- 92, Ed.D.- 89; school psychology, Ph.D.- 97. Residency for the Ph.D. programs is three consecutive semesters of full-time coursework and two consecutive semesters for the Ed.D. The Ph.D. program requires coursework in both a supporting specialization and a cognate area, as well as either foreign language or computer proficiency. Coursework in statistics and research design is a requirement for all students. Pre-
dissertation research participation is a require-
ment in the Ph.D. program. The concentrations/ specializations in counseling psychology, counselor education, and school psychology each require a year-long counseling practice se-
quence and the equivalent of a year's full-time work as an intern in an appropriate counseling setting. The programs in educational psychology and counseling educa-
tion require a year-long counseling practicum ex-
pense in classroom teaching. All doctoral stu-
dents take written comprehensive examinations in the program concentration, supporting specialization and cognate areas. The guide-
lines for each program concentration may be consulted for further requirements.

ACADEMIC COMMON MARKET

An agreement among southern states for sharing graduate programs allows legal resi-
dents of some states to enroll in certain pro-
grams at UT Knoxville on an in-state tuition

basis. The M.S. program in Education Psyc-
holgy is available to residents of the state of South Carolina. Additional information may be obtained from the Residency Assistant in the Office of Graduate Admissions and Records.

GRADUATE COURSES

404 Special Topics (1-3) Instructor-initiated course offered at convenience of department on topics of cur-
rent interest. May be repeated. Maximum 15 hrs. S/NCo only. F

410 Sex Role Development: Implications for Educa-
tion and Counseling (3) Theories and research con-
cerning development of personal sex role and its re-
levance in educational and counseling settings. E

431 Personality and Mental Health (3) Various per-
spectives of mental health with application to education and other social institutions. E

432 The Disadvantaged Student: Psychoeduca-
tional Perspectives (3) Theory and research regarding etiology, psychosocial behavior and appropriate inter-
ventions. E

460 Self-Management in the Helping Professions (3) Applications of self-management strategies to career, social, emotional, and health domains for both helping professionals and their clients. Prereq: Introductory course in psychology or consent of instructor. S/NCo or letter grade. E

493 Independent Study (1-15) Independent inves-
tigation of problems in educational and counseling psy-
chology. May be repeated. Maximum 15 hrs. S/NCo or letter grade. E

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

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

503 Problems in Lieu of Thesis (1-3) May be repeated. Maximum 12 hrs. S/NCo or letter grade. E

504 Special Topics (1-3) Instructor-initiated course offered at convenience of department on topics of cur-
rent interest. May be repeated. Maximum 15 hrs. S/NCo or letter grade. E

510 Psychological Theories of Human Development

Applied to Education (3) Theory and research on emotional, social, and intellectual development over life span with applications to educational and therapeutic settings. Sp

511 Cognitive Development: Implications for Educa-
tion (3) Applications of theory and research related to higher mental problem-solving. Prereq: 510 or consent of instructor. F

515 Educational Applications of Behavioral Theo-
ries of Learning (3) Behavioral theories and research, conditioning, observational learning, and ethological learning theory as they apply to student motivation, discipli-
ne and learning. Sp, Su

516 Educational Applications of Cognitive Learning

Theories (3) Cognitive theory and research, social learning, attribution and information processing as sys-
tems apply to education. Prereq: 515 or consent of instructor. F

518 Educational Specialist Research and Thesis (1-9) May be repeated. Maximum 27 hrs. P/NP only. E

520 Statistics and Research Design: Conceptual (3) Consumer-oriented, conceptual treatment of statistics, research design, and quantitative basics of testing. E

521 Statistics and Research Design: Application (3) Data collection and analysis. Descriptive techniques, estimation, logic of hypothesis testing and selected par-
ametric and nonparametric tests. For Master's students conducting thesis and beginning doctoral students. Use of computer statistical packages. F, Su

525 Formal Measurement in Education and Counsel-
ing (3) Principles of test construction and item analysis. Survey of standardized tests of intelligence, achieve-
m ent, aptitude, vocational interest, attitudes and person-
ality. Prereq: 520 or equivalent. F, Su

526 Informal Methods of Assessment (3) Deve-
lopment and use of rating scales, check-lists, ob-
servation, test scores and case reports in assessment and counseling of children and adults. Prereq: 525. Sp, Su

540 Seminar in School Psychology (3) Essentials of theory and practice of school psychology as professional specialty. Consideration of history and current issues in school psychology. S/NCo only. Sp

541 Psychoeducational Assessment (3) Direct, psy-
chometrical and naturalistic assessment methods in learn-
ingsurveys. Prereq: 521 or equivalent. May be repeated. Maximum 6 hrs. F, Sp

542 Practicum in Psychoeducational Assessment

(3) Application of assessment skills to clients in learning environments. Coreq. 541 or consent of instructor. May be repeated. Maximum 12 hrs. S/NCo only. F, Sp

545 Psychoeducational Consultation (3) Use of two or three-person models of consultation in educational and therapeutical settings. E

546 Practicum in Consultation (3) Application of con-
sulting skills to educational settings. Coreq. 545. Sp

549 Internship in School Psychology (1-6) Su-
pervised employment in departmentally approved school psychology internship sites. Prereq: Enrollment in school psychology program and consent of instructor. May repeated. Maximum 12 hrs. (Same as Psychol-
ogy 549.) S/NCo only. E

550 Development and Operation of Pupil Personnel

Services (3) History, philosophy, trends, standards of preparation, certification of personnel, role identity of counselors, and other personnel service specialists. Program ad-
ministration and organization. F, Su

551 Theory and Practice of Counseling (3) Philo-
osophical bases of helping relationship; development of counselor and client self awareness; counseling theory and techniques. E

Educational and Counseling Psychology 77
552 Career Development: Vocational Theory, Research and Practice (3) Relationship of vocational theory to career development research and societal factors to life career roles. F,Su
553 Career Development: Vocational and Educational Resources (3) Application and use of career and educational resources in personnel planning and program development. Sp,Su
554 Group Dynamics and Methods (3) Theory and types of groups, description of group practices, methods, analysis and facilitative skills, supervision of leadership skills. E
555 Practicum in Counseling (3) Supervised practice and application of counseling skills with individual clients. Prereq: Admission to program. 431, 525, 551 and consent of instructor. May be repeated. Maximum 9 hrs. E
556 Seminar in Community Agency Counseling (1) Orientation to professional organizations, code of ethics, certification requirements, and role identity of community agency counselors. May be repeated. Maximum 2 hrs. S/NC only. E
558 Internship in School Counseling (1-4) Supervised postpracticum employment at departmentally approved site. Prereq: 550 and consent of instructor. May be repeated. Maximum 12 hrs. S/NC only. E
559 Internship in Community Agency Counseling (1-6) Supervised postpracticum employment at departmentally approved human services agency. Prereq: Admission to community agency program, 555 and consent of instructor. May be repeated. Maximum 12 hrs. S/NC only. E
560 Models of Classroom Discipline (3) Applications of major models of discipline in development of constructive atmospheres for classroom learning. Sp,Su
566 Approaches to Family Intervention and Counseling (3) (Same as Child and Family Studies 566.)
570 Cross-Cultural Counseling: Theory and Research (3) Theory and research on issues and problems in counseling of clients from different cultural backgrounds in U.S. and abroad. Sp
585 Seminar in Gerontology (1) (Same as Human Ecology 585, Nursing 585, Physical Education 585, Public Health 585, Psychology 585, Social Work 585, and Sociology 585.)
593 Independent Study (1-15) Independent investigations of problems in educational and counseling psychology. May be repeated. Maximum 15 hrs. S/NC or letter grade. E
600 Doctoral Dissertation (3-15) P/NoP only. E
602 Directed Research (3-13) Instructor- or student-initiated group investigation of empirical and theoretical problems in educational and counseling psychology. May be repeated. Maximum 12 hrs. S/NC only. E
604 Special Topics (1-13) Instructor-initiated courses offered at convenience of department on topics of interest. May be repeated. Maximum 15 hrs. S/NC or letter grade. E
625 Advanced Study in Personality (3) Theory, research and conceptual analysis of studies with application to education and counseling. Prereq: 431 or equivalent. Sp
635 Ethical, Legal, and Professional Issues in Psychology (3) Research, human services, teaching and public policy. Prereq: Admission to doctoral program in psychology, or consent of instructor. (Same as Psychology 635.) Sp
649 Advanced Internship in School Psychology (1-9) Supervised experience as school psychologist in departmentally-approved internship site. Prereq: Admission to national level school psychology program and consent of instructor. May be repeated. Maximum 9 hrs. S/NC only. E
655 Practicum in Counselor Education (3) Supervised practice and application of counseling skills with clients. Prereq: Admission to counselor education program and consent of instructor. May be repeated. Maximum 6 hrs. E
659 Internship in Counselor Education (1-9) Supervised employment in departmentally approved internship sites in counselor education. May be repeated. Maximum 12 hrs. S/NC only. E
660 Seminar in Educational Psychology (1) Major professional issues, role and scope of educational psychology as field of study and practice. Prereq: Admission to doctoral program in educational psychology. May be repeated. Maximum 2 hrs. S/NC only. E
661 Education Implications of Neuropsychology (3) Theory and assessment. Common syndromes and their behavioral and cognitive manifestations. Prereq: 516; and 541 or equivalent individual assessment course; or consent of instructor. Sp
663 Scale Construction (3) Development, pilot testing, and revision of attitude inventories, rating scales, and other paper-and-pencil techniques for assessing beliefs, personality characteristics, and opinion. Prereq: 525, and two-course sequence in statistical analysis. F
664 Cognitive Interventions with Psychopathological Problems (3) Cognitive approaches applied to coping, anxiety, institution, cognitive restructuring, symbolic and social modeling and belief systems. F
665 Analysis of Research in Instructional Technology (3) Research on human learning, design of learning environments. Analysis of teacher behavior, text development, computer software design and video presentations. Sp
668 Practicum in Instructional Planning (3) Development and management of course or program of instruction in education psychology. Prereq: 665, or consent of instructor. E
669 Internship in Educational Psychology (1-6) Supervised employment in departmentally approved educational psychology internship sites. May be repeated. Maximum 12 hrs. S/NC only. E
671 Personality and Vocational Assessment (3) Use and interpretation of personality and vocational measures in assessment of clients. Prereq: 525, 552 or consent of instructor. F
672 Psychological Dysfunction (3) Classification methods and treatment of dysfunctional individuals in counseling. Prereq: 625 and course in abnormal psychology, or consent of instructor. Sp
673 Advanced Theory and Practice in Group Counseling (3) Theories and supervised practice. Prereq: 554, 555, and consent of instructor. Sp
674 Practicum in Counseling Psychology (3) Supervised practice of individual counseling. Minimum 135 clock hrs required each semester. Prereq: Admission to counseling psychology doctoral program, 555, and consent of instructor. May be repeated. Maximum 6 hrs. E
678 Theory and Practice of Counseling Supervision (3) Theories and practice of supervision. Prereq: 665, or 674, or consent of instructor. S/NC only. Sp
679 Internship in Counseling Psychology (1-6) Supervised employment in departmentally approved counseling psychology internship sites. Prereq: Admission to counseling psychology doctoral program and consent of instructor. May be repeated. Maximum 12 hrs. S/NC only. E
683 Independent Study (1-15) Independent investigations of problems in educational and counseling psychology. May be repeated. Maximum 15 hrs. S/NC or letter grade. E

Educational Leadership

MAJORS

DEGREES

College Student Personnel ................................ M.S.
Educational Administration and Supervision ................. M.S., Ed.S., Ed.D.
Education .................................................. Ph.D.

Mary Jane Connelly, Head

Professors:

Coffield, William H. (Emeritus), Ph.D., ................................ Iowa
Goddard, Joseph P., Ed.D. ..................................... Tennessee
Harris, G. W., Jr., Ph.D. ........................................ Michigan
Lovell, J. T. (Emeritus), Ed.D. .................................. Florida
McInnis, Malcolm C., Jr., Ph.D. ................................ Florida State
Petitbone, Timothy J., Ph.D. ..................................... New Mexico
Roney, Robert K., Ed.D. .......................................... Tennessee
Stollar, Dewey H. (Emeritus), ................................... Ohio State
Truett, Frank E. (Emeritus), Ed.D. ................................ Stanford
Ubbern, Gerald C., Ph.D. ......................................... Minnesota
Venditti, Fred P. (Emeritus), ..................................... Northern Colorado

Assistant Professor:

Grubbs, James J., M.S., .......................................... Indiana State

The Department of Educational Leadership offers graduate programs leading to the Master of Science with majors in Educational Administration and Supervision and in College Student Personnel (higher education), the Specialist in Education, the Doctor of Education with a major in Educational Administration and Supervision, and the Doctor of Philosophy with a major in Education. Specializations may be developed in research, major central office positions, the principalship, and in other educational and social agencies.

The Ed.D. program also offers a concentration in higher education. The instructional program combines theory and practice in an innovative demonstration of scholarly study and research. A blend of classroom instruction, individualized advising, and supervised practica and internships allows students to develop a specialization in academic administration, community-junior college administration, student personnel administration, financial management, and college teaching.

For additional information, contact the department head.
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. Application deadlines are February 1, July 1, and October 1.

THE MASTER'S PROGRAM IN EDUCATIONAL ADMINISTRATION AND SUPERVISION

Thesis Option
A minimum of 33 credit hours including 6 hours of Thesis 500 is required. A major consists of a minimum of 18 hours. An internship is highly recommended but not required. A final oral examination is required with a written exam at the option of the committee.

Non-Thesis Option
A minimum of 36 credit hours is required with a minimum of 18 hours in the major. An internship is highly recommended but not required. A final written comprehensive examination is required with an oral exam at the option of the committee.

THE MASTER'S PROGRAM IN COLLEGE STUDENT PERSONNEL

This program is designed for individuals interested in entering the field of student personnel administration in colleges and universities and in community or junior colleges. The program has both a thesis and non-thesis option. A minimum of 39 hours, which includes 6 hours of practicum experience, is required in either option.

Students entering any of the M.S. options must complete the introductory core consisting of Educational Administration and Supervision 513, 515, 516, and 535 or a demonstrated computer proficiency. The courses are prerequisites to other courses in the department.

THE EDUCATIONAL SPECIALIST PROGRAM

Thesis Option
A minimum of 60 hours beyond the baccalaureate degree including 6 hours of Educational Administration and Supervision 518 is required. Six hours must be in a cognate area within the college and 6 hours outside the college. An internship is highly recommended but not required. A written comprehensive examination is given as well as an oral exam over the thesis.

Non-Thesis Option
A minimum of 60 hours beyond the baccalaureate degree including 6 hours of Educational Administration and Supervision 503 is required. Six hours must be in a cognate area within the college and 6 hours outside the college. An internship is highly recommended but not required. A written comprehensive examination is given as well as an oral exam over the problem papers.

THE DOCTORAL PROGRAM

For the Ed.D. program, the minimum hours are determined by the student’s doctoral committee. Six to 9 hours must be in a cognate area within the college and 8-9 hours outside the college unless the student has a Master’s degree in a field outside the College of Education. Two consecutive semesters of 604 must be taken during residency. An internship is highly recommended but not required. A foreign language requirement is at the discretion of the committee. A written comprehensive examination is given as well as an oral exam over the dissertation.

The Ph.D. with a major in Education includes concentrations and specializations as listed under Education.

Educational Administration and Supervision

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 campus time. May be repeated. May be used toward degree requirements. Must be taken during residency. May be repeated. S/NC only. E

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

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 channels, intergroup 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. Introduction to inferential statistics, needs assessments, and evaluation procedures. Sp,Su

518 Educational Specialist Research and Thesis (3) May be repeated. Maximum 6 hrs. P/NP only. E

529 Politics of Education and Educational Environments (3) School/community relations in political context of modern, complex society. Administrator and supervisory competencies; political, social, ethical, 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,Su

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

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

553 Strategies of Educational Planning (3) Processes for improving educational functioning 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: M.S. introductory core or consent of instructor. F,Su

560 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 conjunction with 583 or 588. Prereq: 21 hrs in educational administration and supervision or consent of instructor. F,Su

583 Educational Leadership—Principalship (3) Knowledge, skills and relationships for principal to be effective instructional leader. Simulation materials and field-based activities. Culminating course with internship and problems paper. At end of planned program of study. Prereq: 21 hrs in educational administration and supervision or consent of instructor. F,Su

590 Special Topics (3) May be repeated. E

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

593 Independent Study in Educational Administration (3) Prereq: Consent of instructor. May be repeated. E

595 Elementary Principals Seminar (1-3) For in-service training of elementary school administrators. Development, problems, programs, 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/NC or letter grade. E

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/NC or letter grade. F,Su

597 Secondary Administrator Seminar (1-3) For in-service training of secondary school administrators. Developments, problems, programs, and trends of secondary schools and management skills of secondary school administrators. Prereq: Presently secondary school administrator or consent of instructor. May be repeated. S/NC or letter grade. F,Su

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

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/NC only. E

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 practitioner and University representative. May be repeated at discretion of student’s committee. Maximum 12 hrs. S/NC only. E

611 Current Issues in Educational Administration (1-3) Current topics for practicing school administrators, selected which are offered as present by selected specialist of area. Prereq: Presently school supervisor or administrator, or consent of instructor. May be repeated. S/NC or letter grade. 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 multivariate techniques and applications to various research designs. Prereq: 614 or consent of instructor. Sp

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

622 Programs for the Professional Preparation of Educational Administrators and Supervisors
(3) Exploring designs and methodology for training school administrators at both pre-service and in-service levels. F

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

638 Advanced Supervision
(3) Supervision at district level: roles, responsibilities, and operations: goal development, instructional supervision, staff development, curriculum development, program evaluation, and personnel evaluation. Prereq: 548 or consent of instructor. F/Su

644 Educational Finance and Business Management
(3) Contemporary educational finance policies and their influence upon education, nation and citizens. Supremecintency 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 education. 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

653 Seminar in Educational Planning Methods
(3) Exploration of alternative futures and advanced planning methodology. Sophisticated planning/forecasting techniques. Prereq: 553 or consent of instructor. F/Su

655 State-Federal Relations in Education
(3) Interrelationships of federal, state, and local responsibilities and organization for analysis by analysis of traditional, legal, fiscal and functional aspects of educational partnership. Funding partnerships: discussion of grant proposal development processes. Sp

658 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 sectors of human activity, and current organizational practices for managing destructive conflict. F

660 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

687 Seminar in Educational Facility Planning
(3) Concepts and techniques for evaluating educational facilities, conducting comprehensive school surveys, and developing educational specifications. Prereq: 547 or consent of instructor. Sp

690 Specialized Seminar
(3) Prereq: Consent of instructor. May be repeated. E

693 Independent Study in Educational Administration and Supervision
(3) Prereq: Consent of instructor. May be repeated. E

Higher Education

GRADUATE COURSES

455 Seminar in Student Leadership
(1) Knowledge and skills in leadership roles for resident assistants, student government leaders, student activities, and other student organizations. Topics to be assigned. May be repeated. 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

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

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, dress, organizations, activities fees, tuition and related federal regulations. F

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

570 Introduction to Student Personnel Work
(3) Historical, philosophical and organizational perspectives. 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, human development theory and evaluation assessment techniques. Sp

596 The Community-Junior College
(3) History and role of two-year college, major functions, organization and administration, problems and issues. Sp

593 Independent Study
(3) Prereq: Consent of supervisory instructor. May be repeated. S/NC or letter grade. E

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

619 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/Su

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

640 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 structure in higher education. F/Su

650 Fiscal Problems in Higher Education
(3) Revenue sources, appropriation process, budget procedures, cost analysis, and fiscal management in public and independent colleges and universities. Sp

693 Independent Study
(3) Prereq: Consent of supervisory instructor. May be repeated. S/NC or letter grade. E

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

Electrical and Computer Engineering

(Course Offerings continue on following pages)

MAJOR

DEGREES

Electrical Engineering
.......................... M.S., Ph.D.

Joseph M. Goode, Head

Professors:

Alaxeff, Igor, PE, Ph.D. ............. Wisconsin
Bailey, J. Milton, Ph.D. ............. Georgia Tech
Birdwell, J. Douglas, Ph.D. ......... MIT
Bishop, Asa O., Jr., Ph.D. .......... Clemson
Blalock, T., Vaughn, Ph.D. .......... Tennessee
Bodenheimer, Robert E., Ph.D. .... Northwestern
Bose, Bimal K. (Condra Chair of Excellence), Ph.D. ......... Calculutta
Boudin, Donald W., PE, Ph.D. .... Vanderbilt
Cunningham, James W. (UTSI), Ph.D. ......... Tennessee
Gonzalez, Rafael C. (Distinguished Prof.), Ph.D. ......... Florida
Gooze, Joseph M., Ph.D. ............. Georgia Tech
Green, Walter L., Ph.D. ............. Texas A&M
Hoffman, Graham W., Ph.D. ........ Harvard
Hung, James C. (Distinguished Prof.), Ph.D. ......... Florida
Kennedy, Eldredge J., Ph.D. ........ Tennessee
Lawler, Jack S., Ph.D. ............. Michigan State
Leffell, Will O. (Emeritus), M.S. ..... Tennessee
Neff, Herbert P., PE, Ph.D. ...... Apollo
Pace, Marshall O., PE, Ph.D. ......... Georgia Tech
Pierce, J. Frank (Distinguished Prof.) (Emeritus), PE, Ph.D. ......... Pittsburgh
Rochelle, Robert W. (Emeritus), Ph.D. ......... Maryland
Roth, J. Reece, Ph.D. ............. Cornell
Symonds, Frederick W., Ph.D. ...... Nottingham
Tillman, James D. (Emeritus), Ph.D. .... Auburn
Weaver, Charles H. (Emeritus), PE, Ph.D. ......... Wisconsin

Associate Professors:

Beiz, Ronald A. (UTSI), Ph.D. ........ Tennessee
Bomar, Bruce W. (UTSI), Ph.D. ......... Tennessee
Joseph, Roy D. (UTSI), Ph.D. ......... Case Western
Rosenberg, David, Ph.D. .......... New York
Rochelle, James M., Ph.D. ........ Tennessee
Trivedi, Mohan M., Ph.D. .......... Utah State
Walter, J. Wayne, Ph.D. ............ Tennessee

Assistant Professor:

Abdi, M. A., Ph.D. ............. Tennessee
Brazkovic, Dragana, Ph.D. ......... Florida
Cryly, Paul B., Ph.D. .............. New Mexico State
Koch, Daniel, Ph.D. ............... Missouri (Rolla)
Smith, L. Montgomery (UTSI), Ph.D. ......... Tennessee

Lecturers:

Adams, Raymond K., M.S., P.E. .... Tennessee
Martin, Clyde D., Jr., M.S. ........ Tennessee

DEGREES

Electrical and Computer Engineering

(Dean of Engineering)
THE MASTER’S PROGRAM

Graduate work leading to the Master of Science with a major in Electrical Engineering may be pursued during one academic year of full-time study, or the degree may be obtained in two or three years of study in the evening. Graduate assistantships are available for outstanding students, who may obtain the Master’s degree in one calendar year.

Admission Requirements

Students applying for admission to the Master of Science program and who hold a B.S. in Electrical Engineering are considered for admission on an individual basis. The minimum expectation is an undergraduate cumulative grade-point average of 3.0 or above and a GPA of 3.0 for the senior year. A TOEFL score of 580 is required for international students.

Students who hold the B.S. or B.A. in a field other than electrical engineering are also expected to have a minimum cumulative grade-point average of 3.0 and a minimum senior year average of 3.0 in that field. These students should also have a background equivalent to that obtained by earning credit with a minimum 3.0 grade-point average in the Electrical Engineering courses normally taken at the 200 and 300 levels in the Bachelor’s program in this department, and two senior electrical and computer engineering courses (and any labs other than those in electrical engineering) who have met the admission standards except for this background will be admitted only as non-degree students until they have completed coursework to provide this background.

Master’s Degree Requirements

Specific degree requirements which must be met include:

1. Electrical and Computer Engineering 503 and 504.
2. Six semester hours of graduate credit in mathematics consisting of mathematics courses of 400 level or higher which have been approved by the E.C.E. Graduate Committee.
3. An additional 12 semester hours of 500-level work in electrical and computer engineering courses or 6 semester hours of 500-level work in one area of electrical and computer engineering courses and 6 semester hours of 500-level work in another area approved by the student’s Master’s Committee.
5. A final oral examination covering the thesis and related coursework.

THE DOCTORAL PROGRAM

The Ph.D. with a major in Electrical Engineering may be pursued in the concentration areas of circuit theory, computers, electromagnetics, communication theory, electro-magnetic plasma, energy power systems, solid state electronics, and control systems. Applicants must submit scores on the General Graduate Record Exam. Specific departmental requirements for the Ph.D. include the following:

1. A Master of Science or Master of Engineering degree.
3. A minimum of 3 hours of work in electrical and computer engineering courses at the 500 and 600 levels.
4. A minimum of 9 semester hours of 600-level coursework. At least 3 semester hours of this work must be in an area other than the student’s major area.
5. A minimum of 12 hours of mathematics courses approved by the Electrical and Computer Engineering Graduate Committee. All 12 hours must be 400-level or above, and at least 6 hours must be at 500-level or above.
6. One foreign language in which the student’s facility committee feels that a reading knowledge of a foreign language is crucial to the student’s research efforts.
7. Satisfactory performance on both a qualifying and comprehensive examination. The qualifying examination is prepared by the electrical and computer engineering faculty and consists of a 3-hour written examination in each of four areas. Areas (1) mathematics and transform methods, and (2) basic electrical network analysis, are required of all Ph.D. students. Areas (3) and (4) are usually chosen from two of the graduate course divisions in the department and cover material from undergraduate courses and first year graduate courses. A student who fails the qualifying examination must take and pass the examination the next time it is offered to remain in the Ph.D. program. The qualifying examination is normally taken after the completion of 24 hours of graduate coursework or immediately after completion of a Master’s degree. A minimum of 18 hours of graduate coursework must be completed after the student has taken the qualifying examination the first time.
8. The comprehensive examination is prepared by the student’s doctoral committee and consists of a 3-hour written examination in the student’s major area, a 2-hour written examination in a related area, and an oral examination. The comprehensive examination is normally taken at least six months after passing the qualifying examination. Part of the comprehensive oral examination will be a defense of a formal written dissertation proposal. The comprehensive examination must be passed and the dissertation proposal accepted by the student’s doctoral committee before the student is reported as ready for admission to candidacy for the Ph.D.
10. A minimum of 24 hours of doctoral dissertation.

Many of the electrical and computer engineering courses are offered in the evening. Engineers working in industry are encouraged to participate in the department’s graduate program. Departmental graduate programs are also available at the Space Institute, Tullahoma.

Departmental actions regarding a graduate student may be appealed in writing, first to the Department Graduate Committee and then to the Department Faculty.

GRADUATE COURSES

Courses required in the Electrical and Computer Engineering program cannot be used in either the M.S. or Ph.D. programs. No 400-level course may be used toward a graduate degree in Electrical and Computer Engineering except when required by the program.
application in conventional devices. Differential equations for rotating machinery. Prereq: 422 or equivalent.

529 Advanced Electrical Machines II (3) Park's transformation for analysis of electrical circuits. Prereq: 528.


542 Radiation and Propagation (3) Linear antennas, loop antennas, aperture antennas, optical transmission.Canonical problems of modern geometrical theory of diffraction in both classical and quasidynamic optics approximation, and accountings of far fields and near fields due to edge and surface diffraction. Hooke's law and waveguides. Prereq: 541.

543 Information Systems I (3) Mathematical treatment of information transmission in communication systems; modern components and structures, analog and digital systems. System performance with noise and bandwidth constraints, sampling theorem. Quantization effects: digital-to-analog conversion and real frequency; digital signal processing. Prereq: 504.


545 Introductory Microwave Networks and Components (3) Scattering and transfer representation for multiports: unilateral and bilateral microwave and millimeter wave devices. Component and system parameter measurement by modern network analyzers. Electronic oscillators and amplifiers, frequency sweep oscillators, transient time devices, parametric devices, mixers, switches.


551 Digital System Design I (3) Design considerations for combinatorial and sequential circuits, iterative network. Fault diagnostics of logic circuits.

552 Digital System Design II (3) State identification and structure realizations of sequential machines. Digital system architecture design: microprogramming and interrupt control. Prereq: 551.

561 Plasma Diagnostics I (3) Principles of active, passive, perturbing and nonperturbing diagnostic methods used in low temperature plasmas, and high temperature plasmas of interest in fusion research. Laboratory safety, data reduction and presentation, microprocessor based data handling and analysis, and reduction of time series data. Prereq: 461, 463, or consent of instructor. (Same as Nuclear Engineering 561.)

562 Plasma Diagnostics II (3) Laboratory instruction in operation of modern electronic devices; semiconductors; plasma science laboratory, experience with high voltage, vacuum, RF, and digital data handling techniques. Prereq: 561.

563 Plasma Engineering (3) (Same as Nuclear Engineering 563.)
651 Computer-Aided Design of VLSI Systems I (3)
Fabrication of microelectronic devices; computer architecture design; algorithmic state machines; partitioning; structured design methodology. Prereq: 551-2 or consent of instructor.

652 Computer-Aided Design of VLSI Systems II (3)
Computer-aided design tools; design and implementation of fully custom very large scale integrated (VLSI) circuits; design for testability; testing of fabricated chips. Prereq: 651.

661-2 Advanced Plasma Physics I & II (3, 3)
Basic concepts of high temperature plasma physics, magnetohydrodynamics and kinetic descriptions of plasma, plasma transport, plasma waves, equilibrium, and stability. Prereq: Physics 541-2, 481-2 or 563-4, or consent of instructor. (Same as Physics 663.)

664 Advanced Plasma Physics II (3)
Plasma heating and radiation phenomena. Advanced topics of current interest. Must be taken in sequence. Prereq: 663. (Same as Physics 684.)

671 Image Processing and Robotics I (3)
Three-dimensional scene modeling and recognition, multisensor systems. Prereq: 572 or 573 or consent of instructor.

672 Image Processing and Robotics II (3)
Stereovision, shape theory. Prereq: 671.

673 Image Processing and Robotics III (3)
Time-varying imagery, path planning and navigation. Prereq: 672.

681-82 Quantum Electronics (3, 3)
Prereq: Consent of instructor.

691 Advanced Graduate Seminar (1) Research in department. May be repeated. 5/SNC or letter grade.

692 Special Topics (1-3)
Advanced topics of current interest to Ph.D. students in Electrical Engineering. May be repeated. Maximum 9 hrs.

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**Engineering Science and Mechanics**

(1) MAJOR DEGREES

*Engineering Science* ...........................................  M.S., Ph.D.

Jerry E. Stoneking, Head

Professors:

- Antar, B. (UTSI), Ph.D. .................. Texas
- Carley, T. G., PE, Ph.D. .................. Illinois
- Forrester, J. H., PE, Ph.D. ............... Iowa State
- Forney, J. W., PE, Ph.D. .................. Doctorate
- Frost, W. (UTSI), Ph.D. ................. Washington
- Jendrucko, R. J., PE, Ph.D. .............. Virginia
- Keefler, D. R. (UTSI), Ph.D. ............ Florida
- Kim, K. H., Ph.D. ............................ NC State
- Krieg, R. D., Ph.D. .......................... New Mexico
- Landon, J. D., PE, Ph.D. ................. Lehigh
- Lee, C. W. (Emeritus), Ph.D. .......... Illinois IT
- Lyday, W. A., M.S. .......................... Tennessee
- McCoy, T. D. (UTSI), Ph.D. ............ Auburn
- Phih, H., PE, Ph.D. ........................... Illinois IT
- Remenyik, C. J., Ph.D. .................... Johns Hopkins
- Robertson, R. W. (UTSI), Ph.D. ....... AFIT
- Scott, W. E., Ph.D. .......................... Johns Hopkins
- Shahroki, F. (UTSI), Ph.D. .............. Oklahoma
- Shobe, L. R. (Emeritus), PE, M.S. .... Kansas State

Snyder, W. T., Ph.D. ......................... Northwestern
- Soliman, O., PE, Ph.D. .................. Tennessee
- Stoneking, J. E., PE, Ph.D. .............. Illinois
- Wasserman, J., PE, Ph.D. ............... Cincinnati
- Weitsman, Y. J., Ph.D. .................... Rensselaer

Research Professor:

Morarty, T. F., PE, Ph.D. .................. Illinois

Associate Professors:

- Boudel, J. A. M., Ph.D. .................. Stanford
- Caruthers, J. E. (UTSI), Ph.D. ......... Georgia Tech
- Engles, R. C. (UTSI), Ph.D. ............ VPI
- Mathews, A., PE, Ph.D. .................. Illinois
- McCoy, M. H. (UTSI), Ph.D. .......... Florida
- Steinhoff, J. S. (UTSI), Ph.D. ........ Chicago

Assistant Professor:

Brooks, G. N., Ph.D. ......................... Stanford

Instructor:

- Foster, S., M.S. ...................... Tennessee

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Graduate programs leading to the degrees of Master of Science and Doctor of Philosophy with a major in Engineering Science are available to graduates of recognized curricula in engineering, mathematics, or one of the physical or biological sciences. Program concentrations include solid mechanics, biomechanical engineering, and optical engineering (UTSI only). In each of these concentrations, interdisciplinary programs are arranged to meet individual needs or interests. Each applicant is advised as to any prerequisite courses before entering a program; the student's program of study must be approved by the student's advisory committee, and must comply with the requirements of the Graduate School. The student's major professor may be selected from a department other than the Department of Engineering Science and Mechanics; however, at least one member of the student's graduate advisory committee must be on the faculty of the Department of Engineering Science and Mechanics.

A departmental application is required in addition to The Graduate School application. The names and addresses of four references must be included with the departmental application.

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

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**THE MASTER'S PROGRAM**

Two M.S. options are offered: option I requires a thesis, while option II does not. The second plan is restricted to those students who have had significant engineering professional work experience. In option I, a minimum of 30 semester hours including the thesis is required. In option II, a minimum of 33 hours is required. The requirements include the following:

<table>
<thead>
<tr>
<th>Hours Credit</th>
<th>I</th>
<th>II</th>
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<tbody>
<tr>
<td>Mathematics</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Engineering courses*</td>
<td>Major concentration may include but is not restricted to courses offered by the Engineering Science and Mechanics Department.)</td>
<td>12</td>
</tr>
<tr>
<td>Related courses (May include additional courses in mathematics, computer science, the physical and life sciences as well as engineering courses.)</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Thesis</td>
<td>6</td>
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*Engineering courses under option II may include advanced laboratory work or special problem work; for example, Engineering Science and Mechanics 581 or analogous courses in other departments.

A final examination is required under both options covering graduate coursework and the thesis.

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**THE DOCTORAL PROGRAM**

Specific departmental requirements for the Ph.D. include:

1. A minimum of 72 semester hours beyond the Bachelor's degree, exclusive of credit for the Master's thesis. These shall include a minimum of 24 semester hours in Doctoral Research and Dissertation and a minimum of 48 semester hours in other courses.

2. A minimum of 24 semester hours in engineering graduate courses, exclusive of thesis and dissertation credit. These courses will normally be numbered 500 and above, with at least 9 semester hours of 600-level courses, which constitute one or two areas of concentration selected by the student. The number of courses in this group to be taken will depend on the program selected by the student and the approval of the student's advisory committee.

3. A minimum of 12 semester hours in mathematics or computer science in courses numbered 400 and above, exclusive of a first course in ordinary differential equations.

4. Attendance and participation in graduate seminars and colloquia.

5. Two doctoral examinations must be passed to be admitted to candidacy for the Ph.D. in Engineering Science.

After being admitted as a potential candidate for the Ph.D., a qualifying examination must be taken at the first offering after the student has either completed a Master's degree or completed 24 semester hours of graduate credit. The purposes of qualifying examinations are:

a. To determine the qualifications of the student to continue the Ph.D. program, and
b. To identify the areas of strengths and weaknesses to guide the student's graduate coursework and research.

The qualifying examination will be administered by the department's Graduate Studies Committee. The examination will be written and will cover at least four graduate level subject areas. One subject area will be mathematics, and the others will be designated by the student.
subject to the approval of the department's Graduate Studies Committee. The comprehensive examination is to be taken by students within 6 credit hours of completion of graduate coursework required for the Ph.D. degree. This examination is to be administered by the student's advisory committee and shall consist of both a written and an oral portion. After successfully passing the qualifying and comprehensive examinations, the student must present the Ph.D. dissertation research proposal to the student's advisory committee and receive committee approval of the proposal before being admitted to candidacy for the Ph.D.

7. A final examination on the student's dissertation and related fields will be taken by the student after completion of the Ph.D. dissertation and course requirements.

ACADEMIC COMMON MARKET
An agreement among southern states for sharing graduate programs allows legal residents of some states to enroll in certain programs. Students enrolled in the University of Florida must be approved for admission by the graduate dean of the student's academic college. This permit is available to residents of the state of Florida. Additional information may be obtained from the Residents' Assistant in the Office of Graduate Admissions and Records.

GRADUATE CREDIT FOR 400-LEVEL COURSES
Four hundred-level courses in engineering may be used for graduate credit at the discretion of the graduate program. However, at least two-thirds of minimum required credit hours in a Master's degree program must be at or above the 500 level.

GRADUATE COURSES

421 Materials of Engineering (3) Mechanical properties of engineering materials; data collection and processing; time dependent and cyclic dependent properties. Prereq: 321, Materials Science and Engineering 201, 3 hrs or 2 hrs and 1 lab.

423 Fracture-Safe Design (3) Critical review of variables controlling fracture toughness: part and flaw geometry, temperature, loading rate, section size, material; characterization of fracture toughness by stress intensity factor and crack opening displacement; fracture toughness of steels, titanium alloys, and nonferrous metals. Prereq: 311, 312, 321, 520. 3 hrs or 2 hrs and 1 lab.

425 Principles of Nondestructive Testing (3) Principles and theory of nondestructive testing methods; liquid penetrant, magnetic particle, eddy current, ultrasound, acoustic emission, and radiographic methods. Laboratory. Prereq: 321, Materials Science and Engineering 201. (Same as Physics 475.)

431 Fundamentals of Vibrations (3) Free and forced vibrations of damped and undamped lumped parameter systems; energy methods; free vibration of continuous bodies. Prereq: 231, 312, 321, 322, 431.

433 Dynamic Systems (3) Three dimensional dynamics of particles and rigid bodies; gyroscopes; variable mass systems; central force motion. Lagrange's equations; stability; transfer functions. Prereq: Dynamics.

451 Engineering Acoustics (3) Concepts of acoustics; measurements of sound and their units; noise generation and transmission, noise control principles and application, materials and procedures for noise abatement. Prereq: introductory course in acoustics or acoustics.

442 Fluid Mechanics II (3) Differential forms of basic laws; compressibility, isentropic flow, shocks, duct flows with heat transfer and friction; open channel flow, critical flow, energy methods; internal and external viscous flows, boundary layers, elementary turbulent closure models. Prereq: 341, 421.

461 Experimental Stress Analysis (3) Theory, techniques, and instrumentation of resistance strain gauges; theory and techniques of brittle coating method; introduction to photelasticity. Prereq: 311. 2 hrs and 1 lab.

463 Photomechanics (3) Introduction to photoelasticity; photomechanics, Moiré method, interferometry, and holography. Prereq: 321, 432. 2 hrs and 1 lab.

465 Dynamic Data Acquisition (3) Use and calibration of instrumentation for measuring and recording dynamic events; Fourier analysis, transfer function analysis, digital signal processing, transducers, experimental parameter estimation with applications to modal vibration analysis. Prereq: 451. Electrical and Computer Engineering 301. 2 hrs and 1 lab.

471 Clinical Engineering and Bioinstrumentation (3) Function and characteristics of health care delivery systems: hospital organization and health care economics; development and management principles for hospital based clinical engineering program. Biomedical instrumentation, instrumentation characteristics; performance of transducers, signal conditioning, data readout and storage devices; evaluation of commercially available systems; measurement and procurement methods for custom-designed system, equipment maintenance and control programs for hospitals. Ethical issues and professionalism in clinical engineering. Prereq: Biomedical engineering. Introduction to Pattern Recognition.

473 biomechanics (3) Mechanical properties of living tissues; biomechanics of injury; mechanics of prosthetic devices; biomedical problems related to impact. Prereq: 321.

475 Design of Artificial Internal Organs (3) Design, development and evaluation of artificial internal organs; analysis of transport and flow processes for design optimization; review of currently available devices; federal regulation and ethical considerations. Prereq: 321, 322, 431.


495-6 Special Engineering Science Topics (3,3) Problems related to recent developments and practice. Open to juniors or seniors. Prereq: 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 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

521-22 Advanced Mechanics of Materials (3,3) Three-dimensional transformations for stress and strain, un-symmetrical bending, energy methods, thick-walled pressure vessels, beams on elastic foundation, beam columns, introduction to elementary theory of elasticity. Prereq: 321, 322, 431, 520. 2 hrs and 1 lab.

523 Theory of Elasticity (3) Equations of equilibrium; strain-displacement relations compatibility, and constitutive equations in three-dimensions. Beams, disks, thick-walled tubes, plates with holes; stress concentrations. Airy and complex potential stress function, plane stress and plane strain in rectangular and polar coordinates. Thermal stresses in beams, rings, plates, and shells; thermal buckling problems.

525 Theory of Plates (3) Classical bending theory of thin plates; thick plates; buckling and deflection problems. Prereq: 523 or 525.


536 Advanced Engineering Acoustics (3) Introduction to theory and application of acoustic analysis; vibration of continuous systems, plane and spherical waves, transmission phenomena, measurement of sound absorpting and emitting. Resonators, filters, absorption mechanisms, microphones, ultrasonics, sonar transducers. Prereq: 431 or 435.

539 Continuum Mechanics (3) Cartesian tensors, transformation laws, basic continuum mechanics concepts: stress, strain, deformation, constitutive equations. Conservation laws for mass, momentum, energy. Applications in solid and fluid mechanics.

541 Fluid Dynamics I (3) Kinematic, kinetic and thermodynamic properties of fluids. Development of rate deformation tensor, mass, momentum, and energy conservation equations; non-dimensionalization. Applications of Euler and Navier-Stokes equations: exact solutions, potential flow, transonic, boundary layer, approximations; coupled heat/mass transfer models. Coreq: 539.

542 Fluid Dynamics II (3) Development of basic concepts and governing equations for turbulence and turbulent field motion. Formulation for correlation function, energy spectra, dissipation. Introdution to turbulent transport processes, free turbulence, wall turbulence; use of engineering turbulence closure models; examination of modern numerical and experimental methods. Prereq: 541.


plates and shells; use of representative computer programs in networked mini-computer/work station environment. Prereq: C/C++ graphics, solid models, database management. Prereq: 551.

557 Computational Mechanics Seminar (1) Current developments in computational fluid/thermal/structural mechanics. For departmental thesis students only. May be repeated.

559 Computational Mechanics Laboratory (1) Introduction to networked computer/engineering/work station environment for graphics, computer graphics, numerical methods. Prereq: C++ graphics, solid models, database management. Prereq: 551.

561 Photoelasticity (3) Polarized light; basic principles of photoelasticity; experimental techniques and equipment; numerical methods in photoelastic stress analysis; three-dimensional photoelasticity; and applications. Prereq: Mathematics 431. 2 hrs and 1 lab.

566 Optical Engineering I (4) Wave optics; scalar diffraction theory; introduction to Fourier optics; ray or geometric optics; lens, mirror, gratings; paraxial design methods; introduction to aberrations.

567 Optical Engineering Laboratory I (2) Laboratory in support of Optical Engineering I (566). Prereq or coreq 566.

568 Optical Engineering II (4) Statistical optics; spontaneous and induced emission; black and gray body radiation; incoherent, partial and totally coherent radiation; mutual coherence function; detectors; radiometry. Prereq: 566.

569 Optical Engineering Laboratory II (2) Prereq 567. Coreq 568.


581 Special Topics in Engineering Mechanics (3) Mechanics problems related to recent developments. Prereq: Consent of instructor. May be repeated with consent of instructor.

588 Measurement Science I (3) (Same as Nuclear Engineering 588, Chemical Engineering 588, Civil Engineering 586, Electrical and Computer Engineering 586, Aerospace Engineering 586, and Mechanical Engineering 586.)

589 Measurement Science II (3) (Same as Nuclear Engineering 589, Chemical Engineering 589, Civil Engineering 586, Electrical and Computer Engineering 589, Aerospace Engineering 586, and Mechanical Engineering 589.)

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

621 Analysis and Design of Thin Shell Structures (3) Geometry of surfaces, derivation of thin shell theory for arbitrary shell geometry; selected applications of theory in structural engineering. Prereq: 525 or Civil Engineering 553.


624 Viscoelasticity (3) Viscoelastic constitutive relations; determination of boundary-value problems; wave propagation in viscoelastic materials; stability problems; determinination of viscoelastic properties. Prereq: 523 and 539 of Porous Media Mechanics.

625 Theory of Plasticity (3) Yield conditions; strain hardening; general constitutive equations; plastic potential; uniqueness theorems; extremum and variational principles. Problems in perfectly plastic solids; finite plastic deformations; piecewise linear plasticity. Applications. Prereq: 523.


641 Advanced Topics in Fluid Mechanics and Convective Heat Transfer (3) Convective momentum, heat and mass transfer, boundary layer analysis, stability, transition, turbulence, closure models; Navier-Stokes equations, closure procedures; time and space averaging, large scale structures; high speed flow, reacting, nonreacting, excitation, ionization. Applications in propulsion, laser and fusion technologies. Prereq: 561.

645 Theory of Turbulence (3) Mathematical description of turbulence; isotropic turbulence, energy spectra, Kolmogoroff's hypothesis, large and small eddy structure for turbulent flows; turbulent diffusion by continuous motion; applications to turbulent jets, wakes, pipe flow, and boundary layers. Prereq: 542, (Same as Aerospace Engineering 645.)

651-52 Advanced Topics in Computational Fluid Dynamics (3,3) Approximation theory; analysis of accuracy, convergence, and stability for smooth and non-smooth solutions; shocks, artificial dissipation; two- and three-dimensional, compressible viscous and inviscid flows; potential, Euler and complete Navier-Stokes equations; linear and nonlinear problems, and adaptive grids; steady flows including second-order turbulence closure. Thin layer and parabolic Navier-Stokes equations; multi-dimensional, turbulent and reacting flows. Computer project. Prereq 552.

653-54 Advanced Topics in Computational Solid Mechanics (3,3) Fracture mechanics; singularity solutions; mechanics of crack propagation, deformation, initial strain and initial stress methods, plasticity, creep, unified creep-plasticity theory; geometrically non-linear problems, large deflection, stability; shell structures; analysis of accuracy, convergence; adaptive grids. Prereq: 553.

657 Computational Mechanics Seminar (1) Current developments in computational fluid/thermal/structural mechanics. For departmental thesis students only. May be repeated.

681 Advanced Topics in Engineering Mechanics (3) Advanced problems in mechanics, group or individually. Prereq: Consent of instructor. May be repeated with consent of department.
approved by a committee of two other faculty members. Six semester hours of credit will be given.

Non-Thesis Option: Six hours of additional courses at the 500-600 level, making a total of 30 hours of required coursework.

Language Requirement: Evidence of proficiency in one foreign language, to be fulfilled in one of the following ways:
1. Completion of the second year of a language at college level with a grade of C or better.
2. Completion of French 302 or German 332 at UT Knoxville with a grade of B or better.
3. Passing of the regular Ph.D. foreign language examination as currently administered at UT Knoxville.

Final Examination: A candidate presenting a thesis or creative project must pass a ninety-minute oral examination, consisting of a short thesis defense, but chiefly of questions covering the general history of English and American literature, not merely the coursework taken. A reading list of primary works designed to help the student prepare for these questions is available in the office of the Director of Graduate Studies in English.

A non-thesis student must pass a written examination, followed by a one-hour oral examination, both consisting of the same sort of questions as the examination taken by the thesis student.

Residence Requirement: There is no residence requirement for the M.A., but students should attempt to pursue a full-time program whenever possible.

WRITING CONCENTRATION

The Master's program with writing concentration is intended for those students who plan to do free-lance writing, specialize in teaching writing courses at the college level, or work as professional writers in business or industry. Students who go on to complete the Ph.D. may also find the Master's with writing concentration helpful when they are seeking full-time positions.

Requirements

The requirements for the writing concentration are the same as those for the thesis option above with the following exceptions:

Coursework: Writing students may substitute two 400-level writing courses for two 500-level courses. Students must take at least 9 hours in writing and 9 in literature, the remaining 6 to be selected from any English courses at the proper level. Of the courses in writing, at least 3 must be taken at the 500 level; additional 500-level courses are strongly recommended.

Writing Projects: One of the following writing projects for six hours of credit:
1. A thesis, using research to analyze some aspect of writing or rhetorical theory.
2. A creative work or a collection of poems or short stories, a short novel, a play, or a creative work of non-fiction prose.

The nature and length of each project will be determined by the Director of Graduate Studies after consulting with the student and the project director. In addition to the director, two other English Department faculty members will supervise and approve the project; at least one should be from the literature faculty.

Final Examination: The reading list may be modified by the M.A. examining committee, meeting as a body with the student, to reflect the candidate's particular writing emphasis. However, most of the oral examination should focus upon the literature outlined in the original reading list.

THE DOCTORAL PROGRAM

Requirements

A student must successfully complete a program of study, normally 6 full semesters as outlined below, approved by the candidate's committee or the Director of Graduate Studies in English.

Coursework: At least 57 semester hours beyond the B.A. to include at least 24 semester hours at the 600 level; at least 15 semester hours at the 500 level or above (Only 3 hours of 593 Independent Study may be applied toward the M.A. and 3 after the M.A.); a special course in teaching composition; and 15 additional hours at any level, including the 400 level. Up to 6 of these additional hours may be taken in some cognate field or fields such as history, philosophy, French. These courses may be chosen from those approved for graduate credit. All other coursework must be in the English department. In this coursework, students must normally maintain a 3.5 GPA.

Dissertation: Twenty-four semester hours of dissertation. These represent the research for and writing of the dissertation. The research and dissertation will be directed by a faculty member of the department and approved by a doctoral committee of three or four other faculty members.

Language Requirement: A language examination may be taken in one of the following ways:
1. Two languages approved by the Director of Graduate Studies in English. The requirement for each language may be fulfilled by (a) completion of French 302 or German 332 with a grade of B or better; (b) completion at UT Knoxville of any two courses on the 300 level or above in the foreign language or literature with at least a grade of B in each course; or (c) passing of the regular Ph.D. foreign language examination as currently administered at UT Knoxville.
2. One modern language approved by the Director of Graduate Studies in English. This requirement must be fulfilled by passing a grade of B or better in the language examination given by UT Knoxville and completion of two courses given in the foreign language at the 400 level or above, at least one course to be at the 500 or 600 level. A minimum grade of B must be received in each course.
3. One modern language approved by the Director of Graduate Studies in English and intensive study of the English language. This requirement must be fulfilled by completion of (a), (b), or (c) in option 1. for one foreign language, and completion of 6 semester hours in English language courses with grades of B or better, at least three of which must be from English 508 or 509 History of the English Language. For the other 3 hours, the student may either complete the history of the language sequence or choose one other course in language taught in the Department of English at the 500 or 600 level and approved by the Director of Graduate Studies in English. These courses will not count toward the minimum number of courses for the Ph.D., and anyone electing this language option may not take the comprehensive examination in linguistics.

Examinations:
1. A 4-hour qualifying examination taken before the end of the first year of Ph.D. coursework; this examination is given three times a year, with the M.A. written examination.
2. A comprehensive written examination which will be given to all graduate students approved for Ph.D. coursework required. A student must also have met all requirements for the foreign languages before beginning the first part of the examination.

Dissertation Defense: A one-hour examination on the dissertation and other related areas.

Residence Requirement: Two consecutive semesters as a full-time student. For students not on teaching assistantships, full-time consists of 9 or more hours of coursework and/or dissertation hours each semester. For students on assistantships, full-time consists of at least 6 hours of courses and/or dissertation hours and 3 hours of teaching each semester.

GRADUATE COURSES

401 Medieval Literature (3) Reading and analysis of selected medieval literary masterpieces.

402 Chaucer (3) Reading and analysis of Canterbury Tales and Troilus and Cressida in Middle English.

404 Shakespeare I: Early Plays (3) Shakespeare's dramatic achievement before 1601; Reading and discussion of selected plays from romantic comedies, including Twelfth Night, English histories, including Henry IV; and early tragedy, including Hamlet.

405 Shakespeare II: Later Plays (3) Shakespeare's dramatic achievement between 1601 and 1613; Reading and discussion of selected plays from great tragedies, including Othello; problem plays, including Measure for Measure; and dramatic romances, including The Tempest.

406 Renaissance Drama (3) English theatre between 1550 and 1640 through reading of representative plays by Shakespeare's contemporaries: Marlowe, Webster, Jonson.

409 Spenser and his Contemporaries (3) Principal achievements in prose and poetry of sixteenth century authors; Spenser, Wyatt, Marlowe, More, Sidney, and Bacon.

410 Milton, Donne and their Contemporaries (3) Principal achievements in prose and poetry of seventeenth century authors; Milton, Donne, Marvell; and prose of Browne, Bacon, Walton.

411 Restoration and Eighteenth-Century Poetry and Prose (3) Dryden, Swift, Pope, Johnson, and their contemporaries; major works: Mac Flecknoe, Rape of the Lock, Gulliver's Travels, and Rasselas.

412 British Drama from 1660 to 1800 (3) Playwrights from Dryden and Wycherley to Goldsmith and Sheridan; formal developments: heroic play, comic comedy, affective tragedy, and exemplary drama.

413 The Eighteenth-Century British Novel (3) Deloe to Austen.

414 Romantic Poetry and Prose (1) Wordsworth, Coleridge, and Blake; readings from Lamb, De Quincey, and other prose writers.

415 Romantic Poetry and Prose II (3) Keats, Shelley and Byron; readings from Hazlitt, Peacock, and other prose writers.

416 Victorian Poetry and Prose I (3) Tennyson, Pre-Raphaelites, Carlyle, Newman, and Mill.

419 Victorian Poetry and Prose III (3) Browning, Arnold, Hopkins, Hardy, Ruskins, Darwin, and Wilde.

420 The Nineteenth-Century British Novel (3) Scott to Hardy.
Entomology and Plant Pathology

(College of Agriculture)

MAJOR DEGREE
Entomology and Plant Pathology M.S.

Advisors:

Bernard, Ernest C., Ph.D. Georgia
Gerhardt, Reid R., Ph.D. NC State
Hilty, James W., Ph.D. Ohio State
Johnson, Leander F. (Emeritus). Louisiana State
Shuthards, Carroll J., Ph.D. NC State

The Department of Entomology and Plant Pathology offers a graduate program leading to the Master of Science with a concentration in entomology or plant pathology. Students in entomology may specialize in crop entomology, medical and veterinary entomology, insect biology, insect pest management, or biological control. Students in plant pathology may specialize in foliar and stem fungus diseases, soil-borne diseases, plant nematology, or virology. For specific information, contact the department head.

The Master's Program

Admission Requirements:

For admission to the M.S. degree program, a student must meet all requirements of The University of Tennessee Graduate School and must have completed (1) general botany or biology, 8 hours; (2) advanced biological sciences, 8 hours; (3) general inorganic chemistry, 6-8 hours; (4) organic chemistry, 3 hours. In addition, three completed rating forms and a written statement of career goals and interest in entomology or plant pathology are required.

Degree Requirements:

The program requires a written thesis based on original research and the completion of a minimum of 24 hours of coursework for graduate credit, approved by the student's advisory committee. Included in the course requirements are two acceptable seminar presentations for 1 hour each. An oral final exam must be passed to the satisfaction of the advisory committee after the thesis has been completed. A minor is not required but may be selected at the option of the student. The minor will include at least 6 hours and not more than 10 hours of graduate-level credit in the minor department. The student's committee shall include a member of the faculty from the minor department to assist in designating courses required for the minor.

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 Plant Disease Fungi (4) Morphology, taxonony, biology, and genetics of plant pathogenic fungi. Isolation and identification of plant pathogenic fungi. Prereq: 313 or consent of instructor. 2 hrs and 2 labs. F,A
511 Plant Disease Diagnosis (3) Diagnosis of plant diseases, disease symptoms, causal agents and control measures. Prereq: 510 or consent of instructor, 1 hr and 2 hrs. Su,A
512 Soil-Borne Plant Diseases (3) Causal agents, host-parasite- soil-environment interactions, epidemiology, and control of soil-borne plant diseases. Prereq: 313. 2 hrs and 1 lab. F,A
515 Physiology of Plant Disease (3) Biochemical and physiological processes involved in host-pathogen interactions. Mechanisms of disease resistance. Prereq. Introductory plant physiology and pathology, or consent of instructor.
520 Plant Parasitic Nematodes (4) Morphology, physiology, taxonomy, ecology, and management of plant parasitic nematodes, host-parasitic relationships. Prereq: 6 hrs biological science or consent of instructor. 2 hrs and 2 labs. Sp,A
521 Plant Virology (3) Symptomatology, epidemiology, and management of virus infection; structure, morphology, replication, transmission, purification, characterization, and classification of plant viruses; virology; plant pathogenic viroids, mycoplasmas and spiroplasmas. Prereq: 313 or consent of instructor. 2 hrs and 1 lab. Sp,A
523 Field Crop and Vegetable Insects (2) Identification, biology and management of insects affecting commercial vegetable and home garden crops. Prereq: 321 or basic entomology course. 1 hr and 1 lab. F,A
525 Medical and Veterinary Entomology (3) Morphology, taxonomy, biology and control of arthropod parasites and vectors of pathogens of humans and animals. Ecology and behavior of vectors in relation to pathogen transmission and control. Prereq: 321 or 325, or Zoology, 380, or consent of instructor. 2 hrs and 1 lab. Sp,A
530 Integrated Pest Management (3) Principles and application of biological, cultural, genetic, behavioral, and chemical methods of control to maintain pest populations below economic threshold levels. Prereq: 321, or consent of instructor. (Same as Plant and Soil Science 530). F,A
531 Special Problems in Entomology (1-3) Comprehensive individual study of current problems. May be repeated. Maximum 6 hrs. E
532 Special Problems in Plant Pathology (1-4) Comprehensive individual study of current problems. May be repeated. Maximum 6 hrs. E
533 Concentrated Study in Entomology (1-3) Selected subjects in entomology for advanced students, concentrated in time and subject matter. Prereq: 321 or basic entomology course. May be repeated. Maximum 6 hrs. F, Sp
541 Seminar (1) Review of literature and current research in entomology and plant pathology. May be repeated. Maximum 2 hrs. E

Environmental Practice

(College of Veterinary Medicine)

MAJOR DEGREE
Veterinary Medicine D.V.M.

L. N. D. Potgieter, Head

Assistant Professors:

Farkas, W. R., Ph.D. Duke
Oliver, J. W. D.V.M., Ph.D. Purdue
Potgieter, L. N. D., Ph.D. Iowa State
Reed, C. F. (Emeritus), D.V.M. Ohio State

Post-Doctoral Research Associate:

New, J. C., D.V.M. Texas A&M

See Veterinary Medicine for program description.

Graduate Courses

500 Thesis (1-15) P/NP only, E
501 Special Topics in Environmental Medicine (1-3) Abnormal metabolism, pharmacokinetic studies, toxicologic studies, and techniques in molecular biology, atomic absorption, gas chromatography, ultracentrifugation, effective techniques and radiomicro-assay. Prereq: Consent of instructor. May be repeated. Maximum 6 hrs. 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 In Vitro Evaluation of Toxicity (3) Principles and techniques of in vitro evaluation of toxicity, mutagenesis, carcinogenesis, and teratogenesis. Prereq: Biochemistry 561 and consent of instructor. Sp,A
504 Experimental Animal Surgery (3) Competence in performing humane surgical modifications of experimental animals. Techniques of anesthesia, Drug administration and postoperative care. Prereq: Embryology, para-soilology, physiology and/or consent of instructor. 1 hr and 2 labs. F
505 Pharmacology (4) Principles of pharmacokinetics and pharmacodynamics properties of drugs: mode of action, pharmacologic effects, chemical and physical properties, metabolism, toxicities, important idiosyncrasies and clinical applications. Prereq: Consent of instructor. F
506 Doctoral Research and Dissertation (3-15) P/NP only, E
610 Advanced Topics in Environmental Medicine (1-3) Current and future research methodology, laboratory situation, recent advances in instrumentation in analytical techniques for environmental medicine. Prereq: Consent of instructor. May be repeated. Maximum 6 hrs. E
Finance

(College of Business Administration)

MAJOR DEGREES

Business Administration .......... MBA, Ph.D.

Harold A. Black, Head

Professors:

Black, Harold A., Ph.D. .......... Ohio State
Dorotewich, William W. (Wm. Voight Prof.), Ph.D. .......... Pennsylvania
Goolsby, G. C., Ph.D. .......... Wisconsin (Milwaukee)
Hillard, Jimmy E. (Clayton Prof. of Excellence), Ph.D. .......... Tennessee
Philippatos, G. C. (Distinguished Prof.), Ph.D. .......... New York
Shrives, Ronald E. (Faculty Scholar), Ph.D. .......... UCLA

Associate Professors:

Auxier, A. L., Ph.D. .......... Iowa
Boehm, T. P., Ph.D. .......... Washington (St. Louis)
Wachowicz, J. M., Jr., CPA, Ph.D. .......... Illinois
Wansley, James, W., Ph.D. .......... South Carolina

BUSINESS ADMINISTRATION CONCENTRATIONS

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

MBA Concentration: Finance.

The curriculum offers courses for those interested in careers in corporate financial management, security analysis and investments, banking and financial institutions, and real estate.

Minimum course requirements are three courses: Finance 621, plus two courses from the following: 511, 512, 522, 531, 532, 581, or 582. A fourth finance course of the student’s choice is strongly advised. Courses selected must be approved by the Finance Department MBA advisor.

Ph.D. Concentration: Finance.

Minimum course requirements are finance seminars 641, 642, 651, 652.

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/N only. E

511 Contemporary Issues in Corporate Finance (3) Selected topics in financial management, recent developments that have significant impact on strategic issues in financial management. Capital budgeting, financial and ownership structure, dividend policy and corporate growth and control. Prereq: 501.

512 Problems in Financial Management (3) Readings and cases that apply financial theory to real-world investment, financing, and asset management problems. Prereq: 501.


599 Special Topics in Finance (1-3) Topics vary. Prereq: 501 or consent of instructor. May be repeated. Maximum 6 hrs.

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


642 Seminar in Finance II: Theory of the Firm (3) Financial theory of firm and financial decision making under conditions of uncertainty, equilibrium models of firm. Option pricing, agency theory, capital structure, economics of information, and dividend policy.

651 Advanced Seminar in Finance I (3) Recent theoretical and empirical developments in micro-finance literature. Topics vary. May be repeated. Maximum 6 hrs.

652 Advanced Seminar in Finance II (3) Recent theoretical and empirical developments in macro-finance literature. Topics vary. May be repeated. Maximum 6 hrs.

Food Technology and Science

(College of Agriculture)

MAJOR DEGREES

Food Technology and Science .......... M.S., Ph.D.

Hugh O. Jaynes, Head

Professors:

Collins, J. L., Ph.D. .......... Maryland
Davidson, P. M., Ph.D. .......... Washington State
Draughon, F. A., Ph.D. .......... Georgia
Jaynes, H. O., Ph.D. .......... Illinois
Melton, S. L., Ph.D. .......... Tennessee
Miles, J. T. (Emeritus), Ph.D. .......... Wisconsin
Owen, W. W. (Emeritus), Ph.D. .......... Iowa State
Penfield, M. P., Ph.D. .......... Tennessee

Associate Professors:

Demott, B. J., Ph.D. .......... Michigan State
Loveday, H. D., Ph.D. .......... Kansas State
Mount, J. R., Ph.D. .......... Ohio State
Riemann, M. J., Ph.D. .......... Kansas State

Assistant Professors:

Biawal, R. N., Ph.D. .......... Massachusetts
Christen, G. E., Ph.D. .......... Missouri

The Department of Food Technology and Science offers the Master of Science and Doctor of Philosophy degrees. Students in the doctoral program may choose research in the concentration area of food products, food chemistry, food microbiology, or sensory evaluation of foods. Commodity interests (meats, dairy, fruits, vegetables, bakery products) can be emphasized in any of the areas by careful selection of courses and the research topic. Minors are available in cognate fields. For detailed information, contact the department head.

Graduate School rating forms or letters of recommendation from at least three people are required. Respondents should be familiar with the applicant’s scholastic ability and professional potential.

THE MASTER'S PROGRAM

1. Applicants must have a B.S. in food technology, food science, or a related agricultural or scientific discipline.

2. A thesis is required for the Master’s program. Prior to research for the thesis, the student must develop a detailed written research plan. Registration for 6 hours of 500 Thesis is required.

3. In addition to the thesis requirement, a minimum of 24 semester hours of graduate coursework is required. This work must be approved by the student’s committee and a minimum of 14 hours must be courses numbered above 500. The committee may require additional coursework if the student’s progress or background indicates such need.

4. All students are required to include 2 hours of 501 Seminar in their program and are expected to attend this course and participate in discussions during their Master’s program. Completion of 510 or equivalent is also required.

5. An oral examination covering the thesis and coursework is required.

THE DOCTORAL PROGRAM

1. Completion of a Master’s degree in the field, or a closely related field, or passing a special qualifying examination is required for admission. Scores on the GRE aptitude test are also required.

3. A minimum of 72 hours beyond the Bachelor's degree, excluding credit for the Master's thesis, is required. Of this, 24 semester hours must be 600 Doctoral Research and Dissertation.

4. At least 24 hours of coursework numbered above 500 are required exclusive of doctoral research and dissertation. At least 6 of the 24 hours must be courses numbered above 600.

5. A minimum of 6 hours of courses for graduate credit must be taken outside the Department of Food Technology and Science.

6. All candidates must complete 601 (2 hrs.), and are expected to attend 601 during their Ph.D. program.

7. Each candidate must pass both written and oral comprehensive examinations prior to admission to candidacy. Major professors will advise candidates on competencies expected. A final oral examination is required that includes a defense of the dissertation and subject matter that the student's committee considers appropriate.

**GRADUATE COURSES**

410 Food Chemistry I (3) Reactions of proteins, enzymes, and additives in foods. Physicochemical interactions of food materials. Prereq: Chemistry 110 or equivalent, 2 hrs and 1 lab. F

411 Food Chemistry II (3) Reactions of inorganic compounds, carbohydrates, lipids and vitamins in foods. Prereq: Chemistry 110 or equivalent, 2 hrs and 1 lab. Sp

420 Food Microbiology (2) Physical, chemical and environmental factors moderating growth and survival of foodborne microorganisms, pathogenic and spoilage microorganisms affecting quality of foods and their control. Prereq: Microbiology 210. Coreq: 429. F


430 Sensory Evaluation of Food (3) Principles and methods of sensory evaluation of foods. Prereq: Basic statistics, 2 hrs and 1 lab. F

440 Preservation of Food (3) Prevention of deterioration of spoilage of foods. Methods of preservation. Prereq: Agricultural Engineering Technology 422. 2 hrs and 1 lab. Sp

450 Dairy Products I (3) Procurement, processing and distribution of fluid milk. Manufacture of butter, frozen and condensed dairy products. Prereq: 140 or consent of instructor. 2 hrs and 1 lab. F

451 Dairy Products II (3) Manufacture of cheese and specialized dairy products. Market, standards and grades, product defects, scoring of dairy products. Prereq: 140 or consent of instructor. 1 hr and 2 labs. Sp

460 Meat Products Technology (4) Processing methods for making cured, smoked, fresh, flaked and formed products. Effect of processing methods on product characteristics. Prereq: 360 or consent of instructor. 3 hrs and 1 lab. Sp

470 Food Crop Products (3) Foods from plant foods. Manufacturing systems, quality attributes and utility. Prereq: 3 hrs biological science. 2 hrs and 1 lab. Sp

480 Cereal Science and Bakery Products (3) Chemistry and technology of development, baking of breads and cakes. Prereq: 140 or 411 or equivalent, 2 hrs and 1 lab. F

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

501 Seminar (1) Individual reports and discussion on topics from current literature. May be repeated. Maximum 3 hrs. 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 Instrumental Analysis of Food (3) Modern instrumental methods for control of food manufacturing processes. Prereq: 410-11. 2 hrs and 1 lab. F

511 Color and Flavor of Foods (3) Chemical basis, measurements, and reactions involved in color and flavor changes in foods. Manufacture and application of materials used to modify color and flavor. Prereq: 410-11. 2 hrs and 1 lab. F

520 Food and Industrial Fermentations (3) Microbiology, biochemistry and technology of food-related fermentations involving dairy products, meat, cereals, fruits and vegetables. Production of food ingredients and by-product utilization. Prereq: 420-29, 440. Biochemistry 410 or equivalent. 2 hrs and 1 lab. Sp

521 Advanced Food Microbiology (3) Microorganisms in foods, their identification, characterization and relationship to food processing. Isolation of microorganisms from foods and plant equipment. Prereq: 420-29, 1 hr and 2 labs. Sp

540 Food Product Development (3) Art, science and technology of development and marketing new food products. Prereq: 440. 2 hrs and 1 lab. Sp

550 Advanced Meat Science (3) Physical and chemical changes that occur in conversion of muscle to meat; effect of postmortem treatments on meat quality, composition and palatability, packaging, preservation and quality control. Prereq: 460. 2 hrs and 1 lab. Sp

550 Oilseed Products (3) Chemistry and technology of foods and food ingredients produced from oilseeds. Prereq: 420-11 or equivalent. 2 hrs and 1 lab. Sp

590 Special Topics in Food Technology and Science (1) Critical reviews of current research and production concerns of food industry. May be repeated. Maximum 3 hrs. F

591 Directed Studies (1-3) Research on non-thesis topics chosen by student and major professor. Supervised experience in food industry or governmental laboratories. May be repeated. Maximum 6 hrs. E

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

601 Seminar (1) Reports and directed discussion on research topics from current literature. May be repeated. Maximum 3 hrs. F

620 Food Toxicology (3) Basic and applied concepts in food toxicology, development and marketing of processed foods. Mode of action, prevention and control of food toxicants in food supply. Prereq: 410-11, 521, or consent of instructor. F

640 Advanced Food Processing (3) Role of processing treatments in modification of food properties: texture, flavor and color characteristics. Prereq: 440, 510, 511 or consent of instructor. Sp

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**Forestry, Wildlife and Fisheries**

**(College of Agriculture)**

**MAJORS**

**FORESTRY**

**Wildlife and Fisheries Science**

**DEGREES**

**M.S.**

**S. E.**

**George T. Weaver, Head**

**Professors:**

Barrett, J. W. (Emeritus), Ph.D. ... Syracuse Buckner, E. R., Ph.D. ... NO State Core, H. A. (Emeritus), Ph.D. ... Syracuse Dimmick, R. W., Ph. D. ... Wyoming

**Forber, D. C. (Adjunct), Ph. D. ... Florida**

**Hammitt, W. E., Ph. D. ... Michigan**

**Little, R. L., Ph. D. ... N C State**

**McGee, C. E. (Adjunct), D. F. ... Duke**

**Ostermeier, D. M., Ph. D. ... Syracuse**

**Pelton, R., Ph. D. ... Georgia**

**Ripley, T. H. (Adjunct), Ph. D. ... VPI**

**Schneider, G., Ph. D. ... Michigan State**

**Sharp, J. B., D. P. A. ... Harvard**

**Smalley, G., (Adjunct), Ph. D. ... Tennessee**

**Strange, R. J., Ph. D. ... Oregon State**

**Stumbo, A. A., Ph. D. ... Minnesota**

**Thor, E. (Emeritus), Ph. D. ... NC State**

**Weaver, G. T., Ph. D. ... Tennessee**

**Wilson, J. L., Ph. D. ... Tennessee**

**Woods, F. W., Ph. D. ... Tennessee**

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**Associate Professors:**

**Dearder, B. L., Ph. D. ... Colorado State**

**Hay, R. L., Ph. D. ... Duke**

**Hopper, G. M., Ph. D. ... VPI**

**Nodvin, S. C. (Adjunct), Ph. D. ... Cornell**

**Rennie, J. C., Ph. D. ... NC State**

**Schall, K. F., Ph. D. ... Duke**

**Schiarbaum, S. E., Ph. D. ... Colorado State**

**Smith, K. G. (Adjunct), Ph. D. ... Utah State**

**Smith, W. P. (Adjunct), Ph. D. ... Oregon State**

**Welts, G. R., D. F. ... Duke**

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**Assistant Professors:**

**King, M. M., Ph. D. ... Utah State**

**Winstorfer, P. M., Ph. D. ... Iowa State**

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Graduate study leading to the Master of Science with majors in Forestry and in Wildlife and Fisheries Science is offered by the Department of Forestry, Wildlife and Fisheries. The Master of Business Administration, with a concentration in forest industries management, is available for qualified students. This degree program is offered by the College of Business Administration with participation by the Department of Forestry, Wildlife and Fisheries. The Doctor of Philosophy degree is offered in forest biology, wildlife science, or fisheries science can be achieved through the University's intercollegiate graduate program in Ecology.

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**THE MASTER'S PROGRAMS**

Both thesis and non-thesis options are available for the major in Forestry; a thesis is required in Wildlife and Fisheries Science. For admission, the student must have a Bachelor's degree from an accredited institution in forestry, wildlife, fisheries, or other natural resource area. Applicants must also have taken the general Graduate Record Examination (GRE). Graduate School rating forms or letters of recommendation from three individuals familiar with the applicant's academic ability are required. The department also has an application that must be submitted at the time of application to The Graduate School.

**Thesis Option**

1. Prior to research for the thesis, the student is required to develop a detailed written research proposal. Registration for 6 hours of Thesis (Forestry 500 or Wildlife and Fisheries Science 500) is required.

2. A graduate committee of no fewer than 3 faculty members must be selected by the
Forestry, Wildlife and Fisheries

Graduate Courses

416 Planning and Management of Forest, Wildlife and Fisheries Resources (3) Integrated forest and wildlife management plans and analyzing case studies including conflict resolution. Applicable to majors in Forestry and in Wildlife and Fisheries Science. Prereq: Senior standing. 1 hr and 2 labs. F

525 Management of Forestry, Wildlife and Fisheries Resources (2) Current technologies and management strategies concerning wise uses of forestry, wildlife, and fisheries resources necessary for decision making and implementation. Prereq: 6 hrs of biological sciences or consent of instructor. Not available to students in forestry or wildlife and fisheries science. 4 hrs and 1 lab for six weeks.

Wildlife and Fisheries Science

Graduate Courses

411 Wildlife and Fisheries Techniques (3) Capturing and handling fish and wildlife; population restoration; food habitat sampling; wildlife damage control; marking techniques; fish culture systems; track and sign identification. Prereq: Forestry, Wildlife and Fisheries 317. 1 hr and 2 labs or field. One weekend field trip required. F

443 Fisheries Science (3) Quantification and management of freshwater and marine systems: population estimation, age and growth, biological assessment, and habitat quality. Prereq: Forestry, Wildlife and Fisheries 317 or Biology 230, and 6 hrs of mathematics. 2 hrs and 1 lab. Sp

445 Ecology and Management of Wild Birds (3) Biological and ecological characteristics of game birds, endangered birds, and archetypal animals. Current principles and practices of wild bird management. Prereq: Forestry, Wildlife and Fisheries 317 or Biology 230. 2 hrs and 1 lab. 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

511 Problem Analysis in Forest Resources (3) Problem identification, analysis and solution in forest resource management. Identification, analyze and prepare written report. Topic and report must have approval of graduate committee. Available only to students in non-thesis option for M.S. in Forestry. E

512 Seminar (1) Current developments in Forestry. Prereq: Required of all graduate students in residence in fall. May be repeated. Maximum 2 hrs. S/NC only. F

520 Advanced Forest Tree Biology (3) Growth, reproduction, and physiology of trees; forest ecology; variability and taxonomy of forest trees. Prereq: Grads standing in forestry or biological science, or consent of instructor. Sp,A

523 Advanced Forest Resource Management (3) Investigation of the role of information in public agencies and private firms. Forest organization and computerized regulation systems; financial and economic analysis and effects of specific contemporary alternatives. Overnight field trips. Prereq: Senior-level forest management or consent of instructor. F,A

555 Forest Research Research Methods (3) Evaluation of research methodologies through readings and case studies; techniques of research resource monitoring and research techniques in wildlife research. Prereq: 321 or equivalent and statistics. F

560 Industrial Forestry I (3) Economic structure of forest products industries. Identification and analysis of industry structure and markets, domestic and foreign. Current trends in markets and industrial structure: impacts on short term and strategic planning. Prereq: Senior-level forest management or consent of instructor. F,A

565 Industrial Forestry II (3) Evaluation of alternative strategies for forest products industries. Role of timber and forest products in integrated firm from standpoint of financial and strategic evaluations for different levels of self-sufficiency of supply and of various markets and social aspects of fee and leasehold interests. Other financial and institutional arrangements affecting forest management and marketing strategies for private, industrial firms. Prereq: Senior-level forest management or consent of instructor. Sp,A

570 Management & Policy of Forest Resource Organization (3) Theory and application of management as applied to natural resources; institutional direction and culture, and strategic management. Development of policy as planning tool and as results from conflict resolution. Linkage between policy development and execution, and structure and management of organizations. Prereq: Forest administration and policy or consent of instructor. F,A

580 Advanced Silviculture (3) Silvicultural characteristics, silvicultural practices and techniques applied to commercial important insects and softwoods. In-depth analyses of silvicultural principles involved and tools used, prescribed fire, pesticides, in regeneration and management of stands, components of stand dynamics, & growth/yield. Prereq: Undergraduate silviculture course or consent of instructor. 2 hrs and 1 lab. Sp,A

581 Cytogenetics (3) Chromosome structure and behavior during mitotic and meiotic divisions in relation to structural changes, genetic controls, hybridization, speciation, and polyploidy. Laboratory: normal and aberrant meiotic systems and meiotic evolution from plants and animals. Prereq: Biology 220 and at least 6 additional hrs in biological sciences. (Same as Botany 581.) Sp,A
program planning activities of fisheries and wildlife agencies. Decision-making policies, case histories. Sp. A.

530 Wildlife Diseases (2) Necropsy of birds and mammals. Recognition of various diseases and methods of preparing pathological materials in field and lab. Investigative procedures concerning wildlife diseases. Prereq: 1 yr of biology, 444 or 445, consent of instructor. F.A.

540 Predator Ecology (2) Dynamics of terrestrial vertebrate predator populations in human-altered and relatively unaltered environments. Prereq: 444 or 445 or consent of instructor. F.A.

550 Fish Physiology (3) Mechanisms of circulation, excitation, osmoregulation, and neural and hormonal control of these systems in fishes. Practical applications of fish physiology in water pollution assessment, fish culture and management. Prereq: Senior or graduate standing in biological sciences. Sp. A.

560 Advanced Topics in Wildlife and Fisheries Science (3) Recent advances and concepts, research techniques and analysis of current problems. Prereq: 443, 444, 445, or consent of instructor. May be repeated. Maximum 6 hrs. E.

593 Independent Study in Wildlife and Fisheries Science (1-4) May be repeated. Maximum 6 hrs. E.

French
See Romance Languages.

Geography
(College of Liberal Arts)

MAJOR

DEGREES

M.S., Ph.D.

Sidney R. Jumper, Head

Professors:

Aiken, Charles S., Ph.D. ............................................................ Georgia
Bell, Thomas L., Ph.D. ............................................................ Iowa
Hammond, E. H. (Emeritus), Ph.D. ..................................... California
Jumper, Sidney R., Ph.D. ......................................................... Tennessee
Long, G. (Emeritus), Ph.D. ....................................................... Northwestern
Minkel, C. W., Ph.D. ............................................................... Syracuse
Paladan, C. T. (USTS), Ph.D. ............................................... Denver
Rakoton, B., Ph.D. ................................................................. Northwestern
Schmudde, T. H., Ph.D. ............................................................ Wisconsin
Wilbanks, T. J. (Adjunct), Ph.D. ........................................ Syracuse

Associate Professors:

Blasing, T. J. (Adjunct), Ph.D. .................................................. Wisconsin
Brinkman, L. W., Jr., Ph.D. ....................................................... Wisconsin
Brown, Marilyn (Adjunct), Ph.D. ........................................ Ohio State
Carter, James R., Ph.D. ............................................................ Georgia
Foresta, R., Ph.D. ................................................................. Rutgers
Pulsipher, L., Ph.D. ................................................................. Southern Illinois
Rehder, J. B., Ph.D. ................................................................. Louisiana State

Assistant Professors:

Harden, Carol P., Ph.D. ............................................................ Colorado
Horn, Sally P., Ph.D. ............................................................... California

The department offers the Master of Science and Doctor of Philosophy degrees. The Master's degree emphasizes development of professional competence as a geographer and offers opportunities to gain substantial depth in a concentration or a major technique. An emphasis in geographic information systems is available for students who have appropriate backgrounds in mathematics and computer science. The doctoral program is for those who have demonstrated proficiency in conducting independent research. The department is particularly well-qualified to direct research in geography of the natural environment (biogeography, biological conservation, geomorphology), spatial analysis (especially transportation and location analysis), Latin America, and the American South. Graduate concentrations include nonmetropolitan areas, land use, urban geography, transportation geography, geografía of resources, geography of development, and regional and historical geography of the United States.

THE MASTER'S PROGRAM

The department offers the thesis and non-thesis options for the Master of Science. Both options require a minimum of 30 semester hours beyond the completion of a sound undergraduate major program. At least two-thirds of the total hours in the degree program must be at or above the 500 level and must include 501 (at each offering during residency). 504 and 3 semester hours at the 600 level. In the thesis option, 6 hours must be Thesis 500. A final examination is required in both programs.

THE DOCTORAL PROGRAM

The doctorate is a research degree and is granted only to those who demonstrate proficiency in conducting independent research. Students must have achieved the equivalent of a comprehensive Master's program before they will be admitted to the doctoral program. Course requirements for the degree shall be determined by the student's faculty committee in accordance with specific interests and needs. The program of study must include sufficient coursework within the department, but outside the areas of concentration, to provide a broad foundation and understanding of the discipline. The program must include 504, 515, 599, and (at each offering during residency) 501. A minimum of 12 hours must be earned in related fields outside the department in addition to the dissertation. Additional tools, including languages, will be required as appropriate to the student's areas of research specialization. Examinations required for admission to candidacy include a written comprehensive; written examinations on two special fields; and an oral examination on the student's program, the special fields, and the dissertation proposal. Also required is a final oral examination on the dissertation and on other aspects of the program as determined by the student's doctoral committee.

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 Geography is available to residents of the states of Alabama, Arkansas, Mississippi, South Carolina, Virginia, or West Virginia. The Master's program is also available to residents of Virginia. Additional information may be obtained from the Residency Assistant in the Office of Graduate Admissions and Records.

GRADUATE COURSES

411 Computer Mapping and Geographic Information Systems (3) Concepts, management, and presentation of digital data for spatial analysis: cartographic data structures. Prereq: 310 and knowledge of computer language or consent of instructor. 2 hrs and 1.2-hr lab.

412 Cartography (3) Cartographic techniques applied to design, compilation, and reproduction of maps and other graphics. Prereq: 310 or consent of instructor. 2 hrs and 1.2-hr lab.

413 Remote Sensing: Types and Applications (3) Principles and uses of remote sensing imagery, digital data, and spectral data: geographic interpretation and mapping techniques. Prereq: 310 or consent of instructor.

415 Quantitative Methods in Geography (3) Geographic application of statistical techniques, point pattern analysis, and analysis of areal units. Prereq: Mathematics 115 or two semesters of calculus or consent of instructor.

421 Geography of Folk Societies (3) Geographical study of folk culture, traditional material culture and rural settlement, examples from eastern North America and selected foreign areas. Prereq: 101-02 or 350 or consent of instructor.

425 Historical Geography of the United States (3) Survey of changing human geography of United States during four centuries of settlement and development. Changing population patterns, development of agricultural regions, and patterns of urban-industrial development. Prereq: 361 or consent of instructor.

433 The Land-Surface System (3) Characteristics of surface form, water, vegetation, and surface materials, and their regional interrelationships. People as evaluators and agents of change. Prereq: Geography of the Natural Environment or consent of instructor.

434 Climatology (3) General circulation system leading to world pattern of climates. Climatic change and modification, and interrelationships of climate and human activity. Prereq: Geography of the Natural Environment or Meteorology or consent of instructor.

435 Biogeography (3) Changing distribution patterns of plants and animals on variety of spatial and temporal scales. Effects of continental drift, Pleistocene climatic change, and human activity on world biota. Prereq: Geography of natural environment or consent of instructor.

436 Water Resources (3) Global water resources and hydrologic processes: water availability, flooding, and water quality issues from physical and economic geographic perspectives. Prereq: Geography of the Natural Environment or consent of instructor.

443 Rural Geography (3) Geographical appraisal of rural areas of United States: small towns and urban fringes. Problems and potentials of rural America. Prereq: 101-02 or 141 or 340 or consent of instructor. (Same as Urban Studies 441.)

449 Geography of Transportation (3) Examination of transportation systems, their effects on trade patterns, land use, location problems, and development. Prereq: 141 or 340 or consent of instructor.

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

501 Colloquium in Geography (1) Discussion of departmental research, current research literature, and general topics. Registration required of resident graduate students whenever offered. May be repeated. Maximum 4 hrs. May be applied toward graduate degree. S. NC 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 facilities before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only. E

504 Research Design (3) Geographical research from selection of topic and development of research design through field work and final report.

505 Directed Research (2-6) Research on problems as defined by individual students. Prereq: Written consent of instructor and department prior to registration. May be repeated with consent of instructor. Maximum 9 hrs. S/NC only.

506 Directed Readings (2-6) Readings on topics of interest as defined by individual students. Prereq: Written consent of instructor and department prior to registration. May be repeated with consent of instructor. Maximum 5 hrs. S/NC only.

509 Topics in Geography (2-3) Topics vary. Prereq: Consent of instructor. May be repeated with consent of instructor. Maximum 6 hrs.

512 Topics in Cartography (3) Trends, concepts, problems, and methods in cartography. Prereq: 411 and 412 or consent of instructor. May be repeated with consent of instructor. Maximum 6 hrs.

513 Topics in Remote Sensing (3) Applied research using imagery for interpretation and mapping of geographic phenomena. May be repeated with consent of instructor. Maximum 6 hrs.

515 Topics in Quantitative Geography (3) Applied analysis of research problems utilizing appropriate computer programs; usefulness to geographic research of techniques developed by other disciplines. Prereq: 415 or consent of instructor. May be repeated with consent of instructor. Maximum 6 hrs.

517 Geographic Information Management and Processing (3) Concepts and methods in management of geographic information. Database design, manipulation, sampling and analysis. Prereq: Consent of instructor.

519 Graduate Practicum in Cartography/Remote Sensing (2-6) Prereq: Written consent of department before registration. May be repeated with consent of instructor. Maximum 5 hrs.

521 Topics in Cultural Geography (3) Examination of trends, problems, and methods in cultural geography. Prereq: 421 or consent of instructor. May be repeated with consent of instructor. Maximum 6 hrs.

524 Topics in Political Geography (3) Geographic consequences of public decisions; understanding how administrative and political processes affect public land management, spatial distribution of public goods, and urban morphology. Prereq: Consent of instructor. May be repeated with consent of instructor. Maximum 6 hrs.

525 Topics in Historical Geography (3) Examination of trends, concepts, and methods in historical geography. Prereq: 425 or consent of instructor. May be repeated with consent of instructor. Maximum 6 hrs.

533 Topics in Physical Geography (3) Examination of trends, problems, and methods in physical geography. Database design, manipulation, sampling and analysis. Prereq: Consent of instructor. May be repeated with consent of instructor. Maximum 6 hrs.

535 Topics in Biogeography (3) Examination of trends, problems, and methods in biogeography. Prereq: 435 or consent of instructor. May be repeated with consent of instructor. Maximum 6 hrs.

536 Plant Communities and Plant Geography (4) (Same as Botany 536)

541 Topics in Urban Geography (3) Analysis of research on urban systems, internal morphology, urban problems and urban spatial behavior. Prereq: 441 or consent of instructor. May be repeated with consent of instructor. Maximum 6 hrs.

549 Topics in the Geography of Transportation (3) Examination of trends, problems, and methods in transportation geography and transportation networks. Prereq: 449 or consent of instructor. May be repeated with consent of instructor. Maximum 6 hrs.

550 Regional Geomorphology (3) (Same as Geology 550)

577 Biological Conservation (3) Analytical treatment of politics, policies, and forms of biological conservation as practiced in U.S. and abroad. Prereq: Consent of instructor.

591 Foreign Study (1-15) See page 31. Prereq: Written consent of department prior to registration.

592 Off-Campus Study (1-15) See page 31. Prereq: Written consent of department prior to registration.

593 Independent Study (1-15) See page 31. Prereq: Written consent of department prior to registration.

599 Geographic Concept and Method (3) Traditional and modern geographic thought: readings on nature-scope, problems, and methods of geography. Prereq: Consent of instructor.

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

609 Seminar in Geography (2-3) Topics vary. Prereq: Consent of instructor. May be repeated. Maximum 6 hrs.

625 Seminar in Historical Geography (3) Prereq: 525 or consent of instructor. May be repeated. Maximum 6 hrs.

633 Seminar in Physical Geography (3) Prereq: 533 or consent of instructor. May be repeated. Maximum 6 hrs.

635 Seminar in Biogeography (3) Prereq: 535 or consent of instructor. May be repeated. Maximum 6 hrs.

641 Seminar in Urban Geography (3) Prereq: 541 or consent of instructor. May be repeated. Maximum 6 hrs.

643 Seminar in Rural Geography (3) Prereq: 543 or consent of instructor. May be repeated. Maximum 6 hrs.

649 Seminar in Geography of Transportation (3) Prereq: 549 or consent of instructor. May be repeated. Maximum 6 hrs.

663 Seminar in Geography of the American South (3) Prereq: Consent of instructor. May be repeated. Maximum 6 hrs.

673 Seminar in Geography of Latin American (3) Prereq: Consent of instructor. May be repeated. Maximum 6 hrs.

Geological Sciences

(College of Liberal Arts)

MAJOR

Geology ............................ M.S., Ph.D.

Harry Y. McSween, Head

Professors:

Hatcher, Robert D., Jr. (Distinguished Scientist), Ph.D. ........................................ Tennessee
Klepper, Harry J. (Emeritus), Ph.D. ........................................ Ohio State
Kopp, Otto C., Ph.D. ........................................ Columbia
McLaughlin, Robert E. (Emeritus), Ph.D. ........................................ Pennsylvania
McSween, Harry Y., Ph.D. ........................................ Harvard
Misra, Kula C., Ph.D. ........................................ Western Ontario
Taylor, Lawrence A., Ph.D. ........................................ Lehigh
Walker, Kenneth R. (Carden Prof.), Ph.D. ........................................ Yale
Wallis, James G. (Emeritus), Ph.D. ........................................ North Carolina

Associate Professors:

Broadhead, Thomas W., Ph.D. ........................................ Iowa
Byerly, Don W., Ph.D. ........................................ Tennessee
Clark, G. Michael, Ph.D. ........................................ Penn State
Delcourt, Paul A., Ph.D. ........................................ Minnesota

Driese, Steven G., Ph.D. ........................................ Wisconsin
Dunne, William M., Ph.D. ........................................ Bristol
Labotka, Theodore C., Ph.D. ........................................ Caltech
Williams, Richard T. II., Ph.D. ........................................ Yale
Mora, Claudia I., Ph.D. ........................................ Wisconsin

The Department of Geological Sciences offers both the M.S. and Ph.D. degrees in Geology. Persons interested in these programs should contact the Director of Graduate Admissions in the department.

For admission, an applicant must provide transcripts of previous undergraduate work, two rating forms or letters of recommendation, and GRE scores, including the subject exam in geology (or in another area if geology was not the area of previous university-level concentration). Students are not admitted under provisional or non-degree status.

Prerequisite for both degrees is a Bachelor's degree, including coursework in mineralogy, petrology, stratigraphy, paleontology, structural geology, and field geology. One year each of coursework in calculus and chemistry and one year of coursework in biology, physics, or statistics are also required. Applicants lacking any of these may be admitted, but the deficiencies must be removed within the first year without graduate credit.

THE MASTER'S PROGRAM

The department offers the thesis option in the Master's program. Graduation requires successful oral defense of a written thesis and a minimum 3.0 GPA in graduate coursework.

Course requirements are a minimum of 30 semester hours, including:

1. Six hours of Thesis 500.

2. Registration in 595 during the first two years in residence. Two hours may be counted toward the 30-hour minimum. This requirement may be waived in unusual circumstances.

3. Sixteen hours of geology courses, with at least 14 hours at the 500 or 600 level, including at least one course from each of the following groups:

   Group I: 510, 530, 560, 580.

   Group II: 521, 525, 545, 546, 550, 557, 561.

   Group III: 570, 571, 576, 577.

4. Eight hours of additional graduate coursework.

THE DOCTORAL PROGRAM

The prerequisite for the Ph.D. program, in addition to that for the M.S. program, is either a Master's degree in Geology, or a Bachelor's degree plus completion of 9 hours of coursework from the list in #3, above, including one course from each group. These courses may be taken while completing other course requirements.

Graduation requires passing a comprehensive examination, taken no later than the end of the second year, completion of all course requirements with a minimum 3.0 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 can-
didate will be tested on his/her knowledge of the area concerning the proposed dissertation and of related fields. The candidate is expected to be competent in a wide field of geological sciences.

A minimum of 24 hours of graded coursework is required in addition to the 24 hours of dissertation. The coursework includes the sum of 6 hours of 600-level geology courses, 12 hours of 500-level or higher geology courses, and 6 hours of additional graduate courses. Extra-departmental coursework is encouraged. Registration in 595 is required during the first four years in residence.

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

**GRADUATE COURSES**


420 Paleocology (4) Principles of ecological analysis as applied to studies of fossil communities; 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 Invertebrate Paleontology I (3) Survey of preservational processes and geologically important representatives of Protista, Porifera, Cnidaria, Brachiopoda, and Echinoderms. Functional analysis of morphology, skeletal structures, ecology, and stratigraphic distribution. Prereq: 320 or consent of instructor. 2 hrs and 1 1/2 hr lab.

422 Invertebrate Paleontology II (3) Survey of "higher invertebrates": Annelida and other worms, Mollusca, and Bryozoa. Functional analysis of terigenous clastic rocks; analysis of plant fossils and fossil floras. Prereq: 320 or consent of instructor. 2 hrs and 1 1/2 hr lab.


426 Paleobotany and Palynology (3) Evolutionary history of terrestrial vegetation; examples of fossil record of macrobotanical remains, spores, and pollen. Origin and diversification of Gymnosperms and Angiosperms; changes in floristic provinces through geologic time. Prereq: 102: Botany 310-20 or consent of instructor. (Same as Botany 426.) 3 hrs and 1 lab.

440 Field Geology (6) Summer field course for advanced undergraduate geology majors and first-year graduate students in geology. Taught off-campus at Geology Field Station 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 1/2 hr lab.

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

460 Principles of Geochemistry (3) Application of chemistry 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. Recommended prereq: 330. 2 hrs and 1 lab.

470 Applied Geophysics (3) Basic principles and applications of seismic, gravity, magnetic, and electrical prospecting methods; classification of mineral deposits; petrology of ore-gangue assemblages. Prereq: 310 and 330 or equivalents. Recommended prereq: 450. 1 hr and 1 1/2 hr lab.

480 Principles of Economic Geology (4) Ore-forming processes, classification of ore deposits, survey of different types of mineral deposits with examples, and metallogenesis. Prereq: 310 and 330 or equivalents. Recommended prereq: 450. 1 hr and 1 1/2 hr lab.

485 Principles of Geohydrology (3) Principles governing flow of water through rock systems. Applications to groundwater contamination, ore-forming hydrothermal fluids, and paleohydrology. Geology, general chemistry, and calculus. (Same as Civil Engineering 485.)

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

505 Structure of the Southern and Central Appalachian (2) Structural development of Southern and Central Appalachians from extensional Late Proterozoic to early Paleozoic rift-platform margin through processes related to compressional events producing acrotectonic 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 and X-rays for petrologic studies in clastic rocks. Prereq: 310 and 568 or equivalent. 2 hrs and 1 lab.

520 Advanced Paleontology (3) Detailed analysis of selected groups of fossil organisms; functional morphology, evolutionary development.

521 Data Analysis in Geology and Paleobiology (3) Application of statistical and other quantitative techniques to geological and palynological data. 2 hrs and 1 seminar.

525 Biostatistics (3) Examination of principles of stratigraphy and biostratigraphy through selected case histories. 1 hr and 1 1/2-semester lab.

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. Prereq: 410. 3 hrs and 1 lab.

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 rock types; physical 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 diageneis of resedimented 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 stressing links and similarities across boundaries, unique characteristics of major divisions, provinces, sections, and districts. May be repeated with consent of instructor. Maximum 6 hrs. (Same as Botany 555 and Zoology 555.)

555 Seminar in Quaternary Studies (3) Interdisciplinary examination of contemporary issues in the dynamics of pattern and process in Quaternary landscapes; responses of plant, animal and human populations to environmental changes during glacial/interglacial cycles. Prereq: Consent of instructor. May be repeated with consent of instructor. Maximum 6 hrs. (Same as Botany 555 and Zoology 555.)

556 Quaternary Geology of North America (3) Interpretation of geomorphologic, stratigraphic, and sedimentologic data; classification of Quaternary landscapes in glaciated, periglacial, and nonglacial regions of North America; correlation of major episodes of North American glacial with paleo-oceanographic changes in Atlantic and Pacific Oceans. Prereq: 101 or consent of instructor.

557 Quaternary Paleoclimatology (3) Perturbation, processes, and patterns within Earth's systems; climatic and vegetational responses during last 2.5 million years. Prereq: Consent of instructor.


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


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

569 Experimental Geochemistry Laboratory (1-3) Independent lab study of problems in geochemistry using experimental and analytical techniques. Prereq: Consent of instructor.

570 Advanced Structural Geology (4) Current topics in structural geology and tectonics of mountain belts; recent literature. Prereq: 102 hrs 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 ranges and how they function in increasing continental crust. Examples from different parts of world. Prereq: Structural Geology or consent of instructor.

575 Plate Tectonics and Orogeny (4) Tectonic development of orogenic belts in context of newest aspects of plate tectonic theory; 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) Interpretation of geologic structure and stratigraphy using seismic data, effects of velocity anomalies, multiples and complex reflector geometry. Application of seismic reflection exploration. Prereq: Stratigraphy and sedimentation, structural geology, and 470 or consent of instructor.


580 Ore Petrology (3) Detailed study of selected ore deposits; petrology of ore-gangue assemblages. Prereq: 480 or consent of instructor. 2 hrs and 1 1/2 hr lab.

581 Special Problems in Geology (1-3) Directed study or special topics. Prereq: Consent of instructor. May be repeated. Maximum 10 hrs.

591 Foreign Study (1-15) See page 31.

592 Off-Campus Study (1-15) See page 31.

593 Independent Study (1-15) See page 31.

594 Field Problems in Geology (1-2) Literature study and seminars on specific geologic topics but must be supplemented by extended 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. Registration required each semester except summer for resident full-time graduate students. S/NC only.

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

610 Seminar in Mineralogy (2) May be repeated with consent of department. Maximum 6 hrs.
Germanic and Slavic Languages

Graduate Teaching Assistants in the program should have the opportunity and will be strongly encouraged to instruct at least two foreign languages, subject to staffing needs. Doctoral students are 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 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 Residency Assistant in the Office of Graduate Admissions and Records.

German

GRADUATE COURSES

331-32 Elements of German for Upper-Division and Graduate Students (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 101-02 or 107. 332 may be repeated. Maximum 6 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 the Present (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 425, Spanish 425, 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 games, Proto-Italic, 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, consonant and English-German phonological structures, selected topics in advanced German grammar and syntactic analysis. Prereq: 6 hrs of upper division foreign 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 reused toward degree requirements. May be repeated. S/N C only. E

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

512 Teaching a Foreign Language (3) Practical application of methods for 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 waiver by department.

520 Proseminar (3) Bibliography; methods; illustrative problems; preparation of papers.

521 Works of Dostoevsky in English Translation (3) Crime and Punishment, Brothers Karamazov, and other works. No foreign language credit.

522 Works of Tolstoy in English Translation (3) War and Peace, Anna Karanina, and other works. No foreign language credit.

541-42 Medieval German Language and Literature (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 (3) 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.

560 German Literary Theory and Criticism (3)

561-62 Directed Readings in German Language and Literature (3,3)

571-72 Old Norse Language and Literature (3,3)

591 Foreign Study (1-15) See page 31.

592 Off-Campus Study (1-15) See page 31.

593 Independent Study (1-15) See page 31.

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.

612 Old Saxon (3) Phonology, morphology, and syntax of Old Saxon. 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)

**Health, Leisure, and Safety**

(Continued)
Public Health

Graduate study with a major in Public Health leads to the Master of Public Health (M.P.H.). Three professional preparation concentrations are available: community health education, health planning/administration, and occupational/environmental health and safety. 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. Appropriate forms are available from the department’s program in Public Health. 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.

THE MASTER'S PROGRAM

The M.P.H. is a non-thesis program requiring completion of 38 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 a realistic setting. Students must complete all assigned prerequisite courses and 21 semester hours of the curriculum with a minimum overall GPA of 3.0 prior to placement in the field.

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, Florida, Kentucky, Louisiana, Mississippi, or Virginia. Additional information may be obtained from the Office of Graduate Admissions and Records.

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. Workplace health hazards and problems, 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.
450 Special Topics (3) Prereq: Consent of instructor. May be repeated under different topic. Maximum 6 hrs.
493 Directed Independent Study (1-3) Individual student research or supervised work related to health/field of interest. Specific proposal to instructor before registration. May be repeated. Maximum 12 hrs.
502 Registration for Use of Facilities (3-15) Required semester when student uses University facilities and/or instructor. May be repeated. Maximum 6 hrs.
509 Graduate Seminar in Public Health (1) In-depth discussion of timely topics reflecting scope of public health as discipline and its interrelation with many other academic and professional disciplines. Speakers both internal and external. May be repeated. Maximum 4 hrs. (Same as Nursing 509, Nutrition and Food Science 509, Physical Education 509, and Social Work 509.) S/N C only. E
511 Fundamentals of Industral Hygiene (3) Occupational health hazards and regulations; recognition, evaluation and control of workplace health hazards. Pertinent workplace problems and situations.
512 Industrial Hygiene Controls (4) Activities in comprehensive practice of industrial hygiene controls; procedures for industrial processes. Application of industrial hygiene techniques and instrumentation in solution of workplace hazards.
513 Industrial Hygiene Instrumentation and Sampling (3) Instruments and methods for evaluating industrial environment for personal exposure to chemical and physical stresses; detection, evaluation, demonstration, and lab. Prereq: 511 or consent of instructor.
520 Public Health Policy and Administration (3) Administrative considerations of community-based health care programs and public health practice. Health policy formulation; political-environmental-governmen
tal involvement in health, legal responsibilities, and managerial concepts/techniques/process. F, Su.
521 Organization Theory and Health Care Delivery (3) Administrative and Organization theory related to health facilities, operation and management of commun
ity hospital. Case discussions and problem-solving exercises, managerial functions and skills.
523 Management in Extended Care Settings (3) Management decisions in retirement and long-term care facilities. Opportunity for field experience in supervision and administration of domiciliary health services programs. Management and operation of health services programs. Coordinated placement. May not be taken for credit by occupational health concentration majors. F
530 Biostatistics (3) Application of descriptive and inferential statistical techniques to data for health care analysis. Microcomputer applications, use and interpretation of vital statistics and introductory research methodology preparatory for first course in epidemiology. Prereq: Introductory statistics or consent of instructor.
540 Research Methods in Epidemiology (3) Basic measurement science of public health. Epidemiologic principles; application of discipline’s research methods. Basic measures of risk, concepts of bias and causal reasoning. Study design options and analytic approaches. Prereq: 530. Sp
542 Advanced Epidemiologic Methods (3) Both cohort and case-comparison study designs; construction and interpretation of study, and general attention to calcula
tions and formulas. Professional literature, contemporary perspective of epidemiologic approaches to problem-solving and promote formulation in public health. Prereq: 540 or consent of instructor.
550 Principles and Practices of Community Health Education (3) Theoretical foundations for community health education; opportunities for skill development in variety of educational processes; and introduction to community health analysis.
552 Community Health Problem Solving (4) Dynamics of community organization, community needs assessment, planning, and implementation of program planning and evaluation techniques. Opportunity to practice basic skills in realistic setting. Prereq: 550 or consent of instructor.
560 Theories and Techniques in Health Planning (4) Overview of health planning concepts and methodologies in the health care field. Major elements of planning: formulation and conceptualization
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 Department of Human Performance and Sport Studies.

The M.S. with thesis and non-thesis options requires completion of 30 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 of the need 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 operationalization of modern facility 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
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. Organizational structures, 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 leisure delivery systems in today's society, scope of leisure services, determinants of leisure behavior, and 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) 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, and professional aspects of therapeutic recreation. Basic overview of aspects of leisure delivery systems. Prereq: Consent of instructor. F
521 Leisure Counseling and Facilitation Techniques (3) Investigation of concepts and techniques of leisure counseling, introduction to, and practice of Leisure counseling, both individual and group counseling. Prereq: 520 or consent of instructor. Sp
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 local and state policies of therapeutic recreation services. Prereq: 520. Su
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
590 Graduate Practicum (1-6) Required of all graduate students. 100 clock hrs during semester with agency for 2 hrs credit. Two major phases: work experience and written paper. E
591 Directed Study in Leisure & Recreation (1-6) Detailed study of leisure, 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.
History

(College of Liberal Arts)

**MAJOR DEGREES**

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<th>History</th>
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<td>John Muldoway, Head</td>
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**Professors:**

Bergerson, Paul H., Ph.D. Vanderbilt
Chmieliewski, Edward V., Ph.D. Harvard
Cobb, James C., Ph.D. Georgia
Finger, John R., Ph.D. Washington
Graf, Leroy P. (Emeritus) (Distinguished Prof.), Ph.D. Harvard
Haas, Arthur G., Ph.D. Chicago
Hao, Yen-Ping, Ph.D. Harvard
Haskins, Ralph W. (Emeritus), Ph.D. Harvard
Jackson, Charles O., Ph.D. Emory
Klein, Milton M. (Emeritus) (Distinguished Prof.), Ph.D. Columbia
McDonald, Michael J., Ph.D. Pennsylvania
Wheder, W. Bruce, Ph.D. Virginia

**Associate Professors:**

Becker, Susan D., Ph.D. Case Western
Bing, J. Daniel, Ph.D. Indiana
Bohstedt, John, Ph.D. Harvard
Farris, W. Wayne, Ph.D. Harvard
Fleming, Cynthia G., Ph.D. Duke
Johnson, Charles W., Ph.D. Michigan
Muldoway, John, Ph.D. Yale
Pinckney, Paul J., Ph.D. Vanderbilt
Utley, Jonathan G., Ph.D. Illinois

**Assistant Professors:**

Brummett, Palmira R., Ph.D. Chicago
Dion, Todd A., Ph.D. Wisconsin
Gavitt, Phillip R., Ph.D. Michigan
Lansing, Carol L., Ph.D. Michigan
Matson, Cathy D., Ph.D. Columbia
Plummer, Betty L., Ph.D. Maryland

The Department of History offers graduate study leading to the Master of Arts and Doctor of Philosophy. The M.A. program includes a thesis and non-thesis option and also offers a non-thesis concentration in historic preservation. The doctoral program has concentrations in American or European history with specialization in regional/local American, military/foreign relations, and socioeconomic history. Detailed information may be obtained from the Director of Graduate Studies in History.

All incoming students will be advised by the Director of Graduate Studies.

**THE MASTER'S PROGRAM**

**Admission Requirements**

1. Successful completion of a baccalaureate degree, preferably with a major in History.
2. Acceptable scores on the Graduate Record Examination (general and subject history).

**Academic Standards**

A 3.0 overall GPA is required of graduate students to remain in good standing. The Graduate Awards and Review Committee monitors the progress of all graduate students each semester.

**Thesis Option**

Twenty-four hours of coursework and 6 hours of Thesis 500 for a total of 30 hours are required. The student must complete 510, 3 hours of reading courses (521) and 3 hours of 600-level seminars. A two-hour oral examination covering both the thesis and the general field in which the thesis is written is given at the end of the program.

**Non-Thesis Option**

A total of 30 hours of coursework is required. A student must complete 510, 6 hours of reading courses (521) and 6 hours of 600-level seminars. A two-hour written examination on one field and a one-hour oral examination on the second field are given at the end of the program. As many as 9 related hours may be taken in courses outside the department for either option.

**Concentration in Historic Preservation**

This option is non-thesis program requiring 33 total hours: 18 hours outside the history department, and 15 hours within. Required courses are 6 hours of 521, 3 in historic preservation and 3 in either early American or recent American history.

Students will be examined in two fields: historic preservation and either early American or recent American history.

**THE DOCTORAL PROGRAM**

**Admission Requirements**

1. Acceptable scores on the Graduate Record Examination (general and subject history).
2. Successful completion of the M.A.

**Residence and Coursework**

Students are required to complete a minimum of 50 hours in coursework beyond the Bachelor's degree. Students must take 510 or its equivalent. Students transferring from another institution may count up to 24 hours of coursework toward the required 50 hours. All students pursuing the Ph.D. must take a minimum of 6 related hours outside the department. No fewer than 3 semesters of the 6 semesters of residence work (2 of which must be consecutive semesters) shall be under the supervision of the staff of UT Knoxville.

**Language Requirements**

Candidates must possess a reading knowledge of one foreign language and such additional languages as may be determined by the student's committee. Under normal circumstances, those concentrating in European history will need two languages. The committee may also specify any other research tools, such as statistics, essential for the student's preparation. Upon student petition, the committee may accept in place of a language a one-hour seminar: secondary sources on intra-national topics, Maximum 15 hrs.

**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 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 toward degree requirements. May be repeated. S/NC only. E.
532 Topics in Modern Europe (3) Reading seminar: secondary sources on modern movements and trends that are multinational in focus. Focus varies. May be repeated. Maximum 15 hrs.
533 Topics in European National History (3) Reading seminar: 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 seminar: secondary sources on early North American history. Focus varies. May be repeated. Maximum 15 hrs.
542 Topics in 19th- and 20th-Century United States (3) Reading seminar: secondary sources on 19th- and 20th-century United States. Focus varies. May be repeated. Maximum 15 hrs.