545 The Rehabilitation Interview (3) Interview as used in assessment and planning with people who have disabilities and vocational handicaps.

547 Practicum in Rehabilitation (3) Supervised experience in area of rehabilitation; application of concepts, principles, and skills. Prereq: Consent of instructor.

549 Internship in Rehabilitation Counseling (12) Supervised practice in rehabilitation counseling. Full time clinical experience for second-year students (600 clock hours required).

579 Special Topics (1-3) Prereq: Admission to graduate program. May be repeated. Maximum 9 hours. Letter or Satisfactory/No Credit grading.

592 Assistive Technology in Rehabilitation (3) Technology as applied to needs of school age and post-secondary age students/clients. Delivery of assistive technology services; software programs and assistive devices; delivery systems; interdisciplinary evaluation/planning, and funding issues.

593 Independent Study (1-3) May be repeated. Satisfactory/No Credit or letter grade.

Department of

HEALTH AND EXERCISE SCIENCE

http://hes.utk.edu/grad/safety.html

Thomas W. George, Interim Head
Susan M. Smith, Graduate Liaison

Professors
Bassett, Jr., D., PhD ................................................. Wisconsin
Clarke, B., PhD .......................................................... Virginia Tech
Gorski, J., DrPH .......................................................... UCLA
Hamilton, C., DrPH ..................................................... Oklahoma
Howley, E., PhD ......................................................... Virginia
Koza, A., PhD ............................................................. Michigan
Liemohn, W., PhD ....................................................... Iowa
Welch, H., PhD .......................................................... Florida

Associate Professors
Keel, M., PhD .......................................................... Tennessee
Pursley, R., PhD .......................................................... Iowa
Smith, S., EdD ........................................................... Tennessee
Thompson, D., PhD ..................................................... Virginia
Zhang, S., PhD .......................................................... Oregon

Assistant Professor
Klein, D., PhD .......................................................... Arizona State

Emeriti Faculty
Kirk, R., HSD ............................................................. Indiana
Wallace, B., EdD ......................................................... Northern Colorado

MAJORS DEGREES
Exeise Science ........................................................... MS
Health Promotion and Health Education ................................ MS
Safety ................................................................. MS
Public Health ........................................................... MPH, MS-MPH
Education ............................................................. PhD
Human Ecology ......................................................... PhD

The Health and Exercise Science Department fosters development of those with career interests in health education/promotion, exercise science, public health, and safety. The Department of Health and Exercise Science offers graduate programs leading to degrees, majors, and concentrations in:

Master of Science
Health major
Health promotion and health education concentration
Safety major
Exercise science major
Exercise physiology concentration
Biomechanics/sports medicine concentration

Master of Public Health
Public health major
Community health education concentration
Gerontology concentration
Health planning/administration concentration
Veterinary public health concentration

Master of Science – Master of Public Health (Dual Degree)

Doctor of Philosophy
Education major
Exercise science (exercise physiology or biomechanics/sports medicine) concentration
Human ecology major
Community health concentration

Gerontology Minor
An intercollegiate/interdisciplinary minor in gerontology gives the graduate student an opportunity for combining the knowledge and experience about aging in American society with his/her own major concentration.

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

REQUIREMENTS
Prior to earning more than one-half the total hours required for this minor, students must complete a Declaration of a Minor in the College of Education, Health, and Human Sciences form. Copies of this form are available in the Department of Health and Exercise Science.

Core Experience
Students must complete a core experience of 12 semester hours taken at least from three different departments including nine hours taken from outside the major department. Coursework needs to comply with the following framework:

- Coursework. 9 hours required. A variety of coursework may be taken toward satisfaction of this requirement. Courses which are offered on a regular basis include
- Applied practicum. 2 hours required. Students should register under practicum experiences in the home department of the supervising faculty.
- Health 585. 1 hour required. Cross-listed with participating departments.
- Successful completion of a written comprehensive examination covering subject matter of the minor.

Graduate Committee
At least one faculty member from the Gerontology Policy Committee who is qualified to work with graduate students, must serve on the graduate committee of each student who declares a gerontology minor.
Admission to Candidacy

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

EXERCISE SCIENCE

Exercise Science is dedicated to promoting and integrating scientific research and education on the health benefits of exercise. Through a program of interdisciplinary graduate study, using both experimental and epidemiological methods, students gain a greater understanding of the role of exercise in the prevention of various cardiovascular, metabolic, and musculoskeletal disorders. The exercise science faculty offers graduate degrees (MS and PhD) in two specialties: exercise physiology and biomechanics/sports medicine.

The exercise physiology specialty involves the study of the acute and chronic effects of exercise on the human body. At the master’s level, students may choose from two tracks: (1) adult fitness/cardiac rehabilitation, or (2) applied physiology research. Students may elect to do internships in cardiac rehabilitation at several area hospitals, and are encouraged to take the ACSM Exercise Specialist® exam upon graduation. The PhD program requires course work in the life sciences, physiological chemistry, statistics and advanced topics in exercise physiology. Graduate students collaborate with an exercise physiology faculty member to perform research in the areas of physical activity assessment, metabolism, the health benefits of exercise, and body composition.

The biomechanics/sports medicine specialty involves the study of biomechanical implications to exercise and rehabilitation. This program area focuses on the mechanism, prevention, and rehabilitation of musculoskeletal injuries. The emphases in courses taught in this area include biomechanical as well as medical considerations related to exercise and/or rehabilitation. The PhD program requires course work in engineering mechanics, numerical analysis, statistics, and advanced topics in biomechanics. Graduate students work with biomechanics/sports medicine faculty to pursue research in the areas of biomechanics of lower extremity function, footwear biomechanics, core stability, flexibility, and the biomechanics of injury mechanism and prevention.

GRADUATE ASSISTANTSHIPS

A limited number of graduate assistantships are available for qualified students who are graduates of accredited colleges or universities. These assistantships are open to students in the master’s and doctoral programs. Students interested in these opportunities should file their applications before February. Letters should be addressed to Graduate Assistantships Coordinator, Health and Exercise Science Department, The University of Tennessee, Knoxville, Tennessee 37996-2700.

ADMISSION

Applicants are required to complete the departmental application which will be sent to all persons upon their initial inquiry about the program. This is in addition to the Graduate Application for Admission. Applications from persons who have less than a 3.0 GPA will, in general, not be considered.

The following retention policy applies to all graduate students seeking a degree in the department:

- Graduate students are required to maintain an overall 3.0 GPA.
- 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.
- If a student’s overall GPA remains below 3.0 for a second semester, the student will have his/her degree status revoked.

MASTER OF SCIENCE

Exercise Science Major

Exercise Physiology Concentration

REQUIREMENTS

- Exercise Science 508 (or Health 590), 533, 565, 567, 635, 601 (1 hr seminar, 2 enrollments). Either Exercise Science 501 (project) or 500 (thesis)—must also take a statistics course approved by advisor). Electives approved by advisor from Exercise Science, Nursing, or Nutrition.

Biomechanics/Sports Medicine Concentration

REQUIREMENTS

- Exercise Science 508 (or Health 590), 513, 516, 531, 581 (1-3 hours), 601 (1 hour seminar, 2 enrollments).
- Either Exercise Science 501 (project) or 500 (thesis)—must also take a statistics course approved by advisor). Electives approved by advisor from Exercise Science, Sports Studies, or Biomedical Engineering.

DOCTOR OF PHILOSOPHY

Education Major • Exercise Science Concentration

REQUIREMENTS

- 15 hours in Exercise Science.
- 9 hours in an Exercise Science specialization: biomechanics/sports medicine, exercise physiology, physical activity and population health, or other area approved by committee.
- 3 registrations in Exercise Science 601.
- 6 hours in a cognate selected from outside the student’s major field. The cognate must be related to and supportive of the concentration and specialization.
- 15 hours in research methodologies or research experience.
- 24 dissertation hours.

NOTE: The above are viewed as minimum requirements and are subject to modification by the student’s committee.
HEALTH

MASTER OF SCIENCE
Health Promotion and Health Education Major

A graduate program is available leading to the Master of Science with a major in health promotion and health education (thesis and non-thesis options), requiring completion of 30 semester hours. The program emphasizes research skills development by those already employed in the health professions with each student completing a realistic health-related research proposal as a major developmental activity.

DOCTOR OF PHILOSOPHY
Human Ecology Major • Community Health Concentration

The community health concentration integrates the behavioral and natural sciences with public health, community health education, health promotion and the safety sciences to prepare scholars with an interest in improving the health of the nation.

REQUIREMENTS

- Minimum 21 hours of foundation courses: 610, 620, 6 hours of statistics, 3 hours of specialized research methods, and 6 hours of natural or behavioral sciences.
- Minimum 21 hours in primary specialization: 530, 540, 650, 655, 660 and 6 hours of electives.
- Minimum 12 hours in supporting specialization in a focused area: public health, safety, gerontology or a program approved by doctoral committee.
- Minimum 6 hours in a cognate area.
- Minimum 24 hours of dissertation.

PUBLIC HEALTH

Graduate study with a major in public health leads to the Master of Public Health (MPH). Four professional preparation concentrations are available: community health education, gerontology, health planning/administration, and veterinary public health. The veterinary public health concentration is open to graduates in veterinary medicine. Preparation for professional practice in improving community health emphasizes a population perspective, service-learning and application opportunities through rigorous internships. The MPH program is accredited by the Council on Education for Public Health. A minor in statistics is available to interested MPH students due to public health affiliation with the Intercollegiate Graduate Statistics Program.

Non-degree students must obtain permission from the MPH program director to register for 500-level public health courses. Prerequisite coursework assigned as a condition of admission to the MPH program must be completed promptly, with a grade of B or better, typically within the first semester or two of enrollment in graduate studies.

ADMISSION

A statement of the applicant’s educational and career goals and three rating forms are required. Request application packet from the department. Preferential consideration for admission to degree status shall be given to those with a minimum undergraduate grade point average of 2.8 and with at least one year of professional experience in a health-related occupation. As a restricted program, non-degree admission requires department recommendation. Deadlines for completed applications are 1 February for summer term, 1 April for fall semester, and 1 October for spring semester.

MASTER OF PUBLIC HEALTH
Public Health Major

The MPH is a non-thesis program requiring completion of 38 semester hours of course work including 9 weeks of field practice. The field internship provides a full-time experience with an affiliated public health agency or organization offering one or more health programs. Of importance, field practice allows the student to apply academic theories, concepts, and skills in an actual work setting.

REQUIREMENTS

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.

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

Requirements include:

- Public Health Foundation courses (16 hours): 509, 510, 520, 530, 540, 555
- Internship (6 hours) 587, 588
- Concentration of Study (16 hours)

Recommended electives will be selected by the student in consultation with major advisor. A list of courses is available for each concentration: community health education, gerontology, health planning/administration and veterinary public health.

DUAL MS-MPH PROGRAM

Also offered is a coordinated dual program leading to the conferral of both the Master of Science with a major in nutrition (public health nutrition concentration) and the Master of Public Health. The dual program allows students to complete both degrees in less time than would be required to earn both degrees independently.

The program is designed to meet the needs of students who are interested in the benefits of majors in both nutrition and public health. Therefore, it accommodates the interests of students who plan a career in public health nutrition and want to acquire the knowledge and skills of the nutritionist and public health professional; plan a career in nutrition and want to acquire the knowledge and skills and the perspective of the public health professional; or plan a career in public health and want to acquire the knowledge, skills and perspective of the nutritionist.
ADMISSION

Applicants for the MS-MPH program must make separate application to, and be competitively and independently accepted by, the Department of Nutrition for the MS, Department of Health and Exercise Sciences for the MPH, and the Public Health Academic Program Committee.

Students who have been accepted by both departments may apply for approval to pursue the dual program anytime prior to, or after, matriculation in either or both departments. Such approval will be granted, provided that dual program studies be started prior to entry into the fourth semester of the MS and MPH programs.

REQUIREMENTS

A dual degree candidate must satisfy the requirements for both the MS (public health nutrition concentration) and the MPH degrees, as well as the requirements for the dual program. All candidates for the dual degree must successfully complete Public Health 555, two credits of Seminar in Public Health Public Health 509, and a minimum of 60 credits. The Department of Nutrition will award a maximum of 9 semester hours of credit toward the MS for successful completion of approved graduate level courses offered in the Department of Health and Exercise Science. The department will award a maximum of 11 semester hours of credit toward the MPH for successful completion of approved courses offered in the Department of Nutrition. All courses for which such cross-credit is awarded must be approved by the Public Health Academic Program Committee and the student’s graduate committee. A single block field experience (or public health internship) is required of all students and the analytical field paper incorporates public health nutrition and the student’s public health concentration.

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

APPROVED DUAL CREDIT

MS courses to be counted toward the MPH program must include 10 semester hours of Nutrition 515 and 1 semester hour of Nutrition 509. MPH courses to be counted toward the Master of Science include Public Health 520, 530, and 540.

Gerontology Minor

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

SAFETY

MASTER OF SCIENCE

Safety Major

Graduate study with a major in safety (thesis and non-thesis options) leads to the Master of Science. Graduate students may concentrate in safety management or in emergency management.

The graduate program contributes to the University of Tennessee, Knoxville’s, mission of health protection by preparing safety professionals with the knowledge and skills necessary to create and maintain safer human environments in the workplace (industrial and commercial), home, school, and community. The offering of all core classes and required concentration courses on an evening class schedule enables those working full-time in a safety-related field to pursue the MS with a major in safety on a part-time basis.

REQUIREMENTS

The MS program requires completion of 33 semester hours. Degree requirements include completion of the 18-hour core curriculum and completion of a concentration area (15 hours). Concentration course options include specific courses offered by the Human Resource Development Program, and Departments of Industrial and Information Engineering, Civil and Environmental Engineering, and Political Science (Public Administration) in addition to those offered by the Department of Health and Exercise Science. A list of courses is available for each concentration. Students may elect an internship experience with private industry or non-profit organizations to fulfill part of their course requirements. Curricular experiences will assist graduates in preparation for certified safety professional (CSP) examination.

GRADUATE COURSES

Exercise Science (347)

480 Physiology of Exercise (3) Functions of body in muscular work: physiological aspects of fatigue, training and adaptation to environment. Prereq: Biochemistry and Cellular and Molecular Biology 230 or 440. (Same as Biochemistry and Cellular and Molecular Biology 480.)

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

501 Special Project (3) Culminating experience for non-thesis major. Research study suitable for publication, or practicum requiring special written work. Satisfactory/No Credit grading only.

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. Satisfactory/No Credit grading only.

508 Research in Exercise Science (3) Research for writing of thesis and institutional review board proposals; presentation of research through free communications and poster presentations; calculation and interpretation of statistics related to common research designs used in research; and use of computer software.

509 Graduate Seminar in Public Health (1) (Same as Nursing 509; Nutrition 509; Public Health 509; Social Work 509.)

513 Biomechanics of Orthopedic Rehabilitation (3) Effect of physical activity on musculoskeletal tissue: flexibility development and measurement, surgical implications, and rehabilitation related research.

516 Therapeutic Exercise (3) Current research in therapeutic exercise: role of nervous system, soft tissue healing, proprioception, muscle activation patterns, and strength.

521 Analytic Epidemiology (3) Epidemiologic strategies for evaluating research questions concerning causes, prevention and treatment of morbidity and disability. Presentations by experts working with large population-based datasets. Research process: grant writing and protocol preparation. Prereq: Course in statistics or consent of instructor.

525 Epidemiology of Injury and Violence (3) Epidemiologic methods to describe magnitude and examine etiology of unintentional and intentional injury. Alternative approaches for preventing or controlling occurrence of injury and violence in both general population and high risk sub-populations.

533 Exercise Physiology (3) Physiology of human performance: acute and chronic effects of exercise on metabolic, cardiac, pulmonary, and skeletal systems. Prereq: Human physiology or general physiology, general chemistry, 2 hours and 1 lab.

541 Special Topics (1-3) Advanced study in selected areas of exercise science. May be repeated.

565 Advanced Physiology of Exercise (3) Systematic study of skeletal muscle and metabolism related to acute exercise and physical training: lectures, discussions of major scientific reviews, and appropriate laboratory experiments. Prereq: 480 or 533.


569 Clinical Exercise Physiology (3) Cardiac structure and function; interpretation of 12-lead electrocardiograms, exercise considerations for cardiac and pulmonary patient. Prereq: 480 or 533, and 567.

570 Cardiac Rehabilitation Practicum (1-3) Supervised experience in hospital-based exercise programs for participants with cardiac and/or pulmonary disorders. Use of telemetry monitoring, leading safe exercise regimens counseling participants on safe exercise guidelines. Presenting educational class on topic applicable to participants. Prereq: 533 and 567, or consent of instructor. Coreq: 569. May be repeated. Maximum 6 hours.

581 Biomechanics Instrumentation (1) Kinematic, kinetic and muscle activity measurement of human movements using computerized videography, force platform, electromyography and other relevant instruments. May be repeated. Maximum 3 hours. Satisfactory/No Credit grading only.

585 Seminar in Gerontology (1) (Same as Counselor Education 585; Educational Psychology 585; Health 585; Nursing 585; Public Health 585; Social Work 585; Sociology 585.)

593 Independent Study (1-3) May be repeated. Satisfactory/No Credit or letter grade.

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

601 Research Seminar in Exercise Science (1) Research topics in different aspects of exercise science. May be repeated. Satisfactory/No Credit grading only.

622 Directed Independent Research (3-6) Prereq: Doctoral student or consent of instructor. May be repeated. Satisfactory/No Credit or letter grade.

625 Mortality and Survival (3) Life table and other population-based approaches to studying international and sociodemographic patterns and differentials in mortality, morbidity, and disability. Prereq: 2 graduate statistics courses or consent of instructor.

635 Physical Activity and Positive Health (3) Review of clinical, epidemiological, and experimental evidence concerning relationship and effects of exercise on health-related components of fitness. Prereq: Elementary statistics, 480 or 533 and 567 or consent of instructor. (Same as Public Health 635.)

661 Seminar in Exercise and Applied Physiology (1-3) Selected topics in exercise and environmental physiology. Prereq: 480 or 533. May be repeated with consent of instructor.

664 Research Participation in Exercise Science (1-6) Participation in research with faculty member whose interests coincide with those of student. Satisfactory/No Credit grading only.

681 Practicum (1-3) Intern experience in areas of major interest. May be repeated.

693 Independent Study (1-3) May be repeated. Satisfactory/No Credit or letter grade.

Health (442)

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

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

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

420 Sex Education As It Relates to Human Sexuality (3) Exploration of science of human sexuality. Trends, issues, and content of sex education.

425 Women’s Health (3) Factors influencing women’s health and women consumers in nation’s health service delivery systems. Health problems/concerns of women and techniques for prevention, maintenance and/or correction. (Same as Women’s Studies 425.)

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

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

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

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

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. Satisfactory/No Credit grading only.

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

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

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

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

585 Seminar in Gerontology (1) Scope of gerontology as discipline and as related to other academic and professional disciplines. Speakers both internal and external to the University of Tennessee, Knoxville. Prereq: Consent of instructor. May be repeated. Maximum 3 hours. (Same as Counselor Education 585; Educational Psychology 585; Exercise Science 585; Nursing 585; Public Health 585; Social Work 585; Sociology 585.)

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

593 Directed Independent Studies (1-3) Individual identification and study of health/wellness or health promotion problem/issue. Specific proposal to instructor before registration. May be repeated. Maximum 12 hours.

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

601 Internship/Research in Safety and Health (3-6) (Same as Safety 601.)

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

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

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

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

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

Public Health (839)

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

410 Worksite Health Promotion (3) Foundations of health promotion programs delivered in worksite that revolve around issues relative to employees and management: theory, program design, implementation and evaluation from perspective of health promotion specialist. Prereq: 300.

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

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

585 Seminar in Gerontology (1) Scope of gerontology as discipline and as related to other academic and professional disciplines. Speakers both internal and external to the University of Tennessee, Knoxville. Prereq: Consent of instructor. May be repeated. Maximum 3 hours. (Same as Counselor Education 585; Educational Psychology 585; Exercise Science 585; Nursing 585; Public Health 585; Social Work 585; Sociology 585.)

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

593 Directed Independent Studies (1-3) Individual identification and study of health/wellness or health promotion problem/issue. Specific proposal to instructor before registration. May be repeated. Maximum 12 hours.

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

601 Internship/Research in Safety and Health (3-6) (Same as Safety 601.)

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

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

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

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

660 International Health (3) Study of quality of health, health promotion and health services in countries throughout world. (Same as Public Health 660.)
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 hours. Satisfactory/No Credit grading only. (Same as Exercise Science 509; Nursing 509; Nutrition 509; Social Work 509.)


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

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

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

525 Financial Management of Health Programs (3) Financial management concepts and practices applied to health services programs. Fundamentals of budgeting, revenue, income, deficit, financing, rate setting, financial reporting and control. Opportunities to apply techniques. Prereq: 520 or consent of instructor.

530 Biostatistics (3) Application of descriptive and inferential statistical methods to health-related problems and programs. 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 Principles of Epidemiology (3) Distribution and determinants of health-related outcomes in specified populations, with application to control of health problems. Historical origins of discipline, hypothesis formulation, research design, data and error sources, measures of frequency and association, etiologic reasoning, disease screening, and injury control. Prereq: 545 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, educational interventions, and application of program planning and evaluation techniques. Opportunity to practice 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; systems-oriented planning process. Major elements of planning; formulation and conceptualization of problem, plan design, evaluation and implementation. Health problems of institutions, communities and selected population groups, appropriate diagnoses, and programs for addressing needs.

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

585 Seminar in Gerontology (1)(Same as Counselor Education 585, Educational Psychology 585, Exercise Science 585, Health 585, Nursing 585, Social Work 585, Sociology 585.)

587-588 Internship (3,3,3) Internship (community health education, gerontology, or health planning/administration) in either approved organization or research setting under supervision of designated preceptor. Prereq: MPH major, one semester advance notice and consent of major advisor. 587: available only for approved extended placements. Satisfactory/No Credit grading only.

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

593 Directed Independent Study (1-3) Prereq: Consent of instructor. May be repeated. Maximum 6 hours.

635 Physical Activity and Positive Health (3) (Same as Exercise Science 635.)

650 Health Aspects of Gerontology (3) (Same as Health 650.)

655 Seminar in Nation’s Health (3) (Same as Health 655.)

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

Safety (890)

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

452 Safety Principles and Practices (3) General principles, practices, and procedures in occupational and community safety. Historic and present safety issues, problems and practices addressing safety of individuals and groups in work-site, school, community, transportation, and industrial settings. Prereq: Junior or Senior standing or consent of instructor.

460 Fire Risk Management (3) Development, implementation, and management of comprehensive fire safety program. Basic fire risk management concepts, interpretation of codes and exposure to basic fire analysis techniques. Prereq: Senior standing or consent of instructor.

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

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. Satisfactory/No Credit grading only.

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

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

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

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

536 Safety Instrumentation (3) Selection, calibration, maintenance, and use of sampling instruments available to safety practitioner for evaluating exposures of workers to physical stresses and airborne contaminants.

537 Advanced Emergency Management (3) Advanced study in emergency and hazard mitigation, planning, response and recovery. Theory and practice in identification of appropriate emergency warning systems, hazard assessment, facility inspection, plan development and implementation. Prereq: 535.

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

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

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

601 Internship/Research in Safety and Health (3-6) Field experience. Significant problem identified, researched, and reported in acceptable form. May be repeated. Maximum 6 hours. (Same as Health 601.)
Department of INSTRUCTIONAL TECHNOLOGY AND EDUCATIONAL STUDIES

http://ites.tennessee.edu/

Michael Waugh, Head

Professors
Counts, E., EdD ........................................ Texas A&M
French, R., PhD ........................................ Ohio State
Ray, J., EdD ........................................ Tennessee
Thayer-Bacon, B., PhD ................................ Indiana
Waugh, M., EdD ........................................... Georgia

Associate Professors
Connelly, M., EdD ........................................... Virginia Tech
O’Bannon, B., EdD ........................................... Memphis
Wright, H., PhD ........................................... Toronto

Emeriti Faculty
Allison, C. B., PhD ........................................ Oklahoma
Dessart, D., PhD ........................................ Maryland
Myer, M., EdD ........................................... Florida
Roeske, E., PhD ........................................... Ohio State

MAJOR DEGREES
Instructional Technology and Educational Studies .................. MS, EdS
Education ...................................................................... PhD

The Department of Instructional Technology and Educational Studies offers graduate programs leading to degrees, majors, and concentrations in:

Master of Science
Instructional technology and educational studies major
Cultural studies of educational foundations concentration
Curriculum concentration
Instructional technology concentration

Specialist in Education
Instructional technology and educational studies major
Curriculum concentration
Instructional technology concentration

Doctor of Philosophy
Education major
Cultural studies of educational foundations concentration
Curriculum, educational research, and evaluation concentration
Instructional technology concentration

The mission of the Instructional Technology and Educational Studies Department is to prepare teachers, instructors, curriculum planners, educational technologists, instructional designers, theorists and researchers. For additional information, please visit our Web site.

ADMISSION

Individuals seeking admission to any of the degree programs in the Department of Instructional Technology and Educational Studies must first be admitted to the University of Tennessee, Knoxville (See the Graduate Studies: Admission Requirements section of this catalog). Following the submission of an application for graduate study at the University of Tennessee, Knoxville, individuals must make application to a specific degree program within the Instructional Technology and Educational Studies Department.

Applicants seeking master’s and Specialist in Education degrees may apply for admission at any time. Admission decisions related to these programs will occur throughout the calendar year and students may begin their coursework during any semester.

Applicants seeking admission to one of the PhD program concentrations in the department may apply at any time during the calendar year. However, admission decisions for doctoral applicants will be made only once per year, during the spring semester. Doctoral applicants admitted in the spring semester must matriculate during the fall semester of the same calendar year. Any PhD applicant who is unable to meet these expectations will be required to re-apply for admission at a later date.

Individuals who wish to pursue any of the PhD concentrations within the department must submit an application to the department no later than February 1 in the calendar year in which they intend to matriculate. PhD applicants admitted through this process will be notified by April 1.

Department-Specific Admissions Criteria

Each PhD applicant in ITES is required to submit a current set of GRE scores as part of his/her application. However, the ITES Department does not require MS or EdS applicants to submit GRE scores.

MASTER OF SCIENCE
Instructional Technology and Educational Studies Major

REQUIREMENTS

Instructional Technology and Educational Studies Major • Cultural Studies of Educational Foundations Concentration

<table>
<thead>
<tr>
<th>Concentration</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultural studies of educational foundations concentration</td>
<td>14</td>
</tr>
<tr>
<td>Curriculum concentration</td>
<td></td>
</tr>
<tr>
<td>Instructional technology concentration</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specialization (choose one)</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultural Studies in Education 590 (2), 591, 592. Select two from the following courses: Cultural Studies in Education 511, 539, 544, 545, 549, or 550.</td>
<td>9</td>
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</table>

<table>
<thead>
<tr>
<th>Research</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thesis</td>
<td>6</td>
</tr>
</tbody>
</table>

Total 35

NOTE: To meet program requirements, students must select courses in consultation with a program advisor. Program totals are minimums and some students may be required to complete additional coursework to overcome background deficiencies.
Instructional Technology and Educational Studies Major • Curriculum Concentration (Thesis Option)

<table>
<thead>
<tr>
<th>Hours Credit</th>
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<tbody>
<tr>
<td>Core: 3</td>
</tr>
<tr>
<td>Concentration: 9</td>
</tr>
<tr>
<td>Electives: 18</td>
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<tr>
<td>Research: 3</td>
</tr>
</tbody>
</table>

Total Thesis 30

NOTE: To meet program requirements, students must select courses in consultation with a program advisor. Program totals are minimums and some students may be required to complete additional coursework to overcome background deficiencies.

SPECIALIST IN EDUCATION

Instructional Technology and Educational Studies Major • Curriculum Concentration (Thesis/Non-Thesis)

<table>
<thead>
<tr>
<th>Hours Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core: 6</td>
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<tr>
<td>Concentration: 18</td>
</tr>
<tr>
<td>Research (maximum 3 hours per semester): 6</td>
</tr>
</tbody>
</table>

Total 30

1. Program Prerequisites
2. Core: 6
3. Concentration: 18
4. Research: 6

NOTE: To meet program requirements, students must select courses in consultation with a program advisor. Program totals are minimums and some students may be required to complete additional coursework to overcome background deficiencies.

Instructional Technology and Educational Studies Major • Instructional Technology Concentration (Thesis Option)

<table>
<thead>
<tr>
<th>Hours Credit</th>
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<tbody>
<tr>
<td>Core: 9</td>
</tr>
<tr>
<td>Concentration: 12</td>
</tr>
<tr>
<td>Electives: 3</td>
</tr>
<tr>
<td>Research: 3</td>
</tr>
</tbody>
</table>

Total 33

NOTE: To meet program requirements, students must select courses in consultation with a program advisor. Program totals are minimums and some students may be required to complete additional coursework to overcome background deficiencies.

Instructional Technology and Educational Studies Major • Instructional Technology Concentration (Non-Thesis Option)

<table>
<thead>
<tr>
<th>Hours Credit</th>
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<tbody>
<tr>
<td>Core: 9</td>
</tr>
<tr>
<td>Concentration: 12</td>
</tr>
<tr>
<td>Electives: 9</td>
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<tr>
<td>Research: 3</td>
</tr>
</tbody>
</table>

Total 33

NOTE: To meet program requirements, students must select courses in consultation with a program advisor. Program totals are minimums and some students may be required to complete additional coursework to overcome background deficiencies.

1. Theory and Practice in Teacher Education 517. Select one course in each of the following areas: Educational Foundations; Instructional Technology; Curriculum, Educational Research and Evaluation.
2. Instructional Technology 521, 570, 573, 575.

NOTE: To meet program requirements, students must select courses in consultation with a program advisor. Program totals are minimums and some students may be required to complete additional coursework to overcome background deficiencies.

Instructional Technology and Educational Studies Major • Curriculum Concentration (Thesis/Non-Thesis)

<table>
<thead>
<tr>
<th>Hours Credit</th>
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</thead>
<tbody>
<tr>
<td>Core: 6</td>
</tr>
<tr>
<td>Concentration: 18</td>
</tr>
<tr>
<td>Research (maximum 3 hours per semester): 6</td>
</tr>
</tbody>
</table>

Total 30

1. Program Prerequisites
2. Core: 6
3. Concentration: 18
4. Research: 6

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Instructional Technology and Educational Studies Major • Instructional Technology Concentration (Thesis/Non-Thesis)

<table>
<thead>
<tr>
<th>Hours Credit</th>
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<td>Core: 9</td>
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<tr>
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</tr>
<tr>
<td>Research: 3</td>
</tr>
</tbody>
</table>

Total 33

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2. Instructional Technology 521, 570, 573, 575.

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Instructional Technology and Educational Studies Major • Curriculum Concentration (Thesis/Non-Thesis)

<table>
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<tr>
<th>Hours Credit</th>
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<tbody>
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</tr>
</tbody>
</table>

Total 30

1. Program Prerequisites
2. Core: 6
3. Concentration: 18
4. Research: 6

NOTE: To meet program requirements, students must select courses in consultation with a program advisor. Program totals are minimums and some students may be required to complete additional coursework to overcome background deficiencies.

Instructional Technology and Educational Studies Major • Curriculum Concentration (Thesis/Non-Thesis)

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

Total 33

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1. Theory and Practice in Teacher Education 517. Select one course in each of the following areas: Educational Foundations; Instructional Technology; Curriculum, Educational Research and Evaluation.
2. Instructional Technology 521, 570, 573, 575.

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Instructional Technology and Educational Studies Major • Curriculum Concentration (Thesis/Non-Thesis)

<table>
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<tr>
<th>Hours Credit</th>
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<tbody>
<tr>
<td>Core: 6</td>
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<tr>
<td>Research (maximum 3 hours per semester): 6</td>
</tr>
</tbody>
</table>

Total 30

1. Program Prerequisites
2. Core: 6
3. Concentration: 18
4. Research: 6

NOTE: To meet program requirements, students must select courses in consultation with a program advisor. Program totals are minimums and some students may be required to complete additional coursework to overcome background deficiencies.
DOCTOR OF PHILOSOPHY
Education Major

REQUIREMENTS
Education Major • Cultural Studies of Educational Foundations Concentration

**Hours Credit**

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>Program Prerequisites</td>
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<tr>
<td>Departmental Core</td>
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<td>Concentration</td>
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<td>Specialization</td>
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<tr>
<td>Research</td>
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<tr>
<td>Cognate</td>
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<tr>
<td>Dissertation (Instructional Technology and Educational Studies 600)</td>
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<tr>
<td>Total</td>
<td>82</td>
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</tbody>
</table>

Students entering the PhD program with a concentration in cultural studies must possess a master’s degree in a related field of study.

Program Prerequisites

1. Instructional Technology and Educational Studies 601 (3).
2. Select one course in each of the following areas: Cultural Studies in Education 607; Instructional Technology 521 or 679; Curriculum, Educational Research and Evaluation 534, 558, 675, or 676.
4. Select three courses in one of the following areas: Philosophy of Education (Cultural Studies in Education 526, 530, 544, 547, 548, or 608); Sociology of Education (Cultural Studies in Education 545, 549, 648, or 652); History of Education Cultural Studies in Education 511, 539, 546, 609, or 625.
5. Both qualitative and quantitative research methodologies must be included. Curriculum, Educational Research and Evaluation 520; Research Methods Electives (12).

NOTE: To meet program requirements, students must select courses in consultation with a program advisor. Program totals are minimums and some students may be required to complete additional coursework to overcome background deficiencies.

Education Major • Curriculum, Educational Research, and Evaluation Concentration

**Hours Credit**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit</th>
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<tbody>
<tr>
<td>Program Prerequisites</td>
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<td>Departmental Core</td>
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<td>Concentration</td>
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<td>Specialization</td>
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<tr>
<td>Research</td>
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<tr>
<td>Cognate</td>
<td>15</td>
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<tr>
<td>Dissertation (Instructional Technology and Educational Studies 600)</td>
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<tr>
<td>Total</td>
<td>81</td>
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</table>

1. Independent on student background.

Program Prerequisites

1. Instructional Technology and Educational Studies 601 (3).
2. Select one course in each of the following areas: Cultural Studies in Education 550, 592, or 607; Instructional Technology 521 or 679; Curriculum, Educational Research and Evaluation 676.
4. Both qualitative and quantitative research methodologies must be included. Curriculum, Educational Research and Evaluation 520; Research Methods Electives (12).

NOTE: To meet program requirements, students must select courses in consultation with a program advisor. Program totals are minimums and some students may be required to complete additional coursework to overcome background deficiencies.

Education Major • Instructional Technology Concentration

**Hours Credit**

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>Program Prerequisites</td>
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<td>Departmental Core</td>
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<td>Concentration</td>
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<td>Cognate</td>
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<tr>
<td>Research</td>
<td>15</td>
</tr>
<tr>
<td>Dissertation (Instructional Technology and Educational Studies 600)</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>81</td>
</tr>
</tbody>
</table>

1. Students entering the PhD program with a concentration in IT must possess a Master’s degree in IT or a closely related field; or complete Instructional Technology courses 521, 570, 573, 575; or show evidence of comparable course work or work experience.
2. Instructional Technology and Educational Studies 601 (3). Select one course in each of the following areas: Cultural Studies in Education 550, 592, or 607; Instructional Technology 679; Curriculum, Research and Evaluation 534, 558, 675, or 676.
3. Instructional Technology 678; other Instructional Technology electives (12).
4. Both qualitative and quantitative research methodologies must be included. Curriculum, Educational Research and Evaluation 520; Research Methods Electives (12).

NOTE: To meet program requirements, students must select courses in consultation with a program advisor. Program totals are minimums and some students may be required to complete additional coursework to overcome background deficiencies.

GRADUATE COURSES
Cultural Studies in Education (271)


526 Philosophy of Education (3) Description, interpretation, and critique of philosophical/theoretical arguments: truths, knowledge and values in relation to education.

539 Development of Education Thought (3) Historic and philosophic approach to lives and writing of influential educators: Plato, Quintillian, Comenius, Rousseau, Pestalozzi, Freibedel, Dewey. Prereq: Graduate status and consent of instructor.

544 Survey of Contemporary Philosophies in Education (3) Current debates within various philosophical fields of study related to education.

545 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.

546 Topics in History of Education (3) May be repeated.

547 Topics in Philosophy of Education (3) May be repeated.

548 Transforming Critical Thinking: Constructive Thinking and Educational Implications (3) Critique and transformation of critical thinking to more holistic, relational, and aesthetic model of multicultural and gender-sensitive constructive thinking; confronting power and addressing educational implications.

549 Topics in International Education (3) Historical, philosophical, and sociological foundations; selected nations and their cultures. May be repeated.

550 Multicultural Education (3) Introduction to history, varieties, theory and practice of multicultural and multicultural education. Addresses the promotion and critique of multicultural education and related concepts in theory and educational practice.

560 Introduction to Qualitative Research in Education (3) Fundamentals of qualitative research methods and development of skills needed for qualitative research proposals. Overview of qualitative research methods: ethnography, case study, historiography, biography, oral and life history. Critical reading and evaluation of qualitative research studies.

561 Qualitative Research in Education Settings (3) Implementing and writing qualitative studies in educational settings. Qualitative data collection, analysis, and report writing. Prereq: 560 or equivalent.

590 Cultural Studies Seminar (2) Two-semester sequence (fall and spring); ongoing discussion about cultural studies: popular culture, interdisciplinary sport, social justice issues. Presentations, videos, readings. May be repeated. Maximum 4 hours. Satisfactory/No Credit grading only.

591 Issues in Cultural Studies (3) Combination of theoretical readings in cultural studies and service learning for social justice project. Discussion of interdisciplinary, social justice and activism. Links between theory and practice of cultural studies.

592 Justice, Schools, and Sports (3) Social justice issues: education and sport practices. Social justice, moral commitments to others in educational and sport settings, and equal opportunity to acquire social goods and benefits. Prereq: Admission to doctoral program with concentration in cultural studies in education.

607 Advanced Seminar in the Social Foundations of Education (3) Interdisciplinary team-taught seminar. Readings selected by faculty and participants from classic studies and current periodical literature in anthropology, sociology, history, and philosophy of education. Part of general core for PhD program. Prereq: Doctoral student in Education.

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.
609 Feminist Theories and Education (3) Theoretical research currently presented by feminist scholars questioning traditional (male) theories; application of these feminist theories to current feminist work in education.

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.

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


Curriculum, Educational Research, and Evaluation (256)

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

532 Instructional Research: Analysis and Application (3) Analysis of research on instruction. Translation and application of research findings into instructional performance.

534 Program Evaluation in Education (3) Issues and practices in planning and conducting program and curriculum evaluation in variety of settings. Fundamentals of design, measurement, philosophy, ethics, and underlying values; proper role and use of evaluation in educational organizations. Prereq: Consent of instructor. (Same as Educational Administration and Policy Studies 534.)

541 The High School Curriculum (3) Identification of problems associated with curriculum study, Tennessee curriculum framework, assessment of trends in programs of local, regional, and national significance.

552 School Law for Educators (3) Case and statutory material for public school educators; problems concerning law and public education.

557 The Junior High and Middle School Curriculum (3) Curriculum and instructional design for junior high and middle school. Characteristics of students, curriculum designs, instructional patterns, and organization and structure of junior high and middle school.

558 Curriculum Planning and Development (3) Foundations and principles of curriculum planning and development. Historical analysis of curriculum theory, principles of planning and development, and classroom applications for improved learning.

560 Student Assessment (3) Processes for assessing and reporting student progress; interpretation and use of available assessment data. Methods of assessment other than tests and measurements: portfolios, performance tasks, exhibitions.

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.

588 Instructional Theory and Design (3) Relationship of curriculum to instruction; examination of instructional and related learning theories; instructional models and teaching styles.

604 Seminar in Curriculum and Instruction (1) Required 2 consecutive semesters. Satisfactory/No Credit grading only.

623 Using Research for Curriculum Improvement (3) Research methodology; application to descriptive/survey curricular materials. Critical reading of research, methodological development in descriptive and survey areas.

630 Seminar in Assessment and Evaluation (3) Trends and issues in student/ client assessment, personnel evaluation, and program evaluation; and examination of current state, regional and national assessment and evaluation projects. Prereq: Consent of instructor.

631 Application of Assessment/Evaluation (3) Systems designs, instruments, procedures, reporting formats used in personnel and program evaluation and student assessment; analysis, synthesis and interpretation of data sets. Prereq: 630.

672 Interpretation and Application of 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.

674 Designing and Implementing Personnel Assessments (3) Models and methods for assessing performance of educators and other professionals. Critique of systems currently in use and design of evaluation system.

675 Curriculum Evaluation: Theory and Application (3) Evaluation trends and issues. Theoretical frameworks to design evaluation studies for various educational programs.


Instructional Technology (569)

521 Computer Applications in Education (3) Use and integration of technology in educational settings to support teaching and learning. Prereq: Basic computer operations or consent of instructor.

566 Administering Instructional Media Programs (3) Leadership roles and responsibilities of professional media administrator in variety of organizational settings.

569 Media and Technology Production Techniques (3) Workshop strategy: basic photography, audio production, multi and single camera TV production, basic digital video editing, and other media/technology techniques important for improving communication in variety of presentation or instructional settings. (Same as Information Sciences 569.)

570 Instructional Systems Design (3) Application of theory and research of instructional systems design to solve instructional problems in educational settings.

571 Desktop Publishing for Educators (3) Use of computer-based desktop publishing and graphics software and related hardware in designing and producing instructional and informational products. Prereq: 521, 570, or consent of instructor.

573 Introduction to Multimedia in Instruction (3) Selected computer-based multimedia production tools and use to produce instructional materials based on specific learner characteristics and objectives. Prereq: 521 or consent of instructor.

575 The Internet: Implications for Teaching and Learning (3) Investigation of Internet, its origin and historical development. Hands-on use of Internet. Relevant issues regarding legal and ethical issues, evaluation, responsible use, proprietary rights.

576 Advanced Interactive Multimedia for Instruction (3) Design and production of educational and interactive Web sites using advanced software. Development of effective interactive methods for enhancing teaching and learning supported by principles of planning, designing, creating, testing, and evaluating. Prereq: 521, 570, 573, 575.

578 Web Design (3) Design and development of instructional Web sites using basic design principles and visual Web editor software. Prereq: 575.

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

678 Seminar in Instructional Technology (1) Readings and discussions based on current literature, research, theories and practices in instructional technology. Prereq: Consent of instructor. May be repeated. Maximum 3 hours.


680 Designing Problem-Based Learning Environments (3) Development and integration of problem-based learning pedagogy into curriculum. Examination of literature to understand theoretical perspective for design of this type of learning environment. Prereq: 521, 570, 573, 575, or consent of instructor.

Instructional Technology and Educational Studies (570)

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

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. Satisfactory/No Credit grading only.

503 Problems in Lieu of Thesis (2-3) May be repeated. Maximum 9 hours. Satisfactory/No Credit grading only.

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

593 Independent Study (1-3) May be repeated. Satisfactory/No Credit or letter grade.

594 Supervised Readings (1-3) May be repeated. Satisfactory/No Credit or letter grade.

595 Special Topics (1-3) May be repeated. Satisfactory/No Credit or letter grade.

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

http://nutrition.utk.edu/grad/internship.html

Jay Whelan, Head
Michael Zemel, Graduate Liaison

Professors
Haughton, B., EdD ....................................................... Columbia
Karlstad, M., PhD ....................................................... Loyola
Moussa, N., PhD ....................................................... Paris
Sachan, D., PhD ....................................................... Illinois
Whelan, J., PhD ....................................................... Penn State
Zemel, M., PhD ....................................................... Wisconsin

Associate Professor
Bailey, J., PhD ....................................................... Iowa State

Assistant Professors
Bittle, J., PhD ....................................................... Tennessee
Jones, S., PhD ....................................................... North Carolina
Kim, J., PhD ....................................................... Tennessee
Truett, G., PhD ....................................................... Georgia
Young, E., PhD ....................................................... Georgia

Emeritus Faculty
Skinner, J., PhD ....................................................... Oregon State

MAJORS  DEGREES
Nutrition ................................................................. MS, MS-MPH
Human Ecology ........................................................ PhD

The Department of Nutrition offers graduate programs leading to degrees, majors, and concentrations in:

Master of Science
Nutrition major
Nutrition science concentration
Public health nutrition concentration

Master of Science – Master of Public Health (Dual Degree)

Doctor of Philosophy
Human ecology major
Nutrition science concentration

The Master of Science program is available with a major in nutrition and concentrations in nutrition science or public health nutrition.

A graduate degree combined with a Dietetic Internship (DI) beyond the baccalaureate degree qualifies the graduate to apply for the Registration Examination to become a Registered Dietitian (RD). Students may learn more from the department about the D.I. program from the departmental Web site. The Dietetic Internship is currently granted accreditation by the Commission on Accreditation for Dietetics Education of The American Dietetic Association, 120 S. Riverside Plaza, Chicago, IL 60606-0040, telephone: (312) 899-5400. Students may also select an interdisciplinary minor in gerontology.

ADMISSION

A complete file for review includes the Graduate Application for Admission file, completed departmental application form, Graduate Record Examination (GRE) scores for the general section, and three Graduate Rating Forms completed by individuals who can attest to the applicant’s potential for graduate education. Forms may be obtained from the Departmental Office, 229 Jessie Harris Building, University of Tennessee, Knoxville, 37996-1900. Forms may also be obtained from the department’s Web site.

Admission into the graduate program in the department is dependent on completion of undergraduate courses that give the necessary background for success in the graduate program. Required undergraduate courses include: general and organic chemistry, physiological chemistry/biochemistry, physiology, statistics and advanced nutrition. Admission to the PhD program with a major in human ecology and a concentration in nutrition science requires a master’s degree. Applicants to all programs with related experience may be given preference.

MASTER OF SCIENCE

Nutrition Major

REQUIREMENTS

Students may choose a thesis or non-thesis option in nutrition. Attendance of Nutrition 540 is required every semester.

Thesis Option

The program consists of a minimum of 33 hours with at least 16 hours of coursework in the department.

• Nutrition 511, 512, 540, 541 and 3 hours of graduate level statistics are required.
• Students in public health nutrition must take 511, 512, 513, 514, 515, 541 and the minor in public health.

• Six hours of Thesis 500, and 6 hours outside the department are required.
• A minimum of 22 hours at the 500 or 600 level is required.
• An oral comprehensive examination is required upon completion of the thesis.

Non-Thesis Option

The program consists of a minimum of 36 hours with at least 20 hours of coursework in the department.

• Nutrition 511, 512, 540, 541, 2 hours from 542-544 and 3 hours of graduate level statistics are required.
• Students in public health nutrition must take 511, 512, 513, 514, 515 and the minor in public health.

• Six hours in one area outside the department are required.
• A minimum of 24 hours at the 500 and 600 level is required.
• A written comprehensive examination is required for completion of the program.
DUAL MS-MPH PROGRAM

The College of Education, Health, and Human Sciences offers a coordinated dual program leading to the conferral of both the Master of Science with a major in nutrition (public health nutrition concentration) and the Master of Public Health. The dual program allows students to complete both degrees in less time than would be required to earn both degrees independently.

The program is designed to meet the needs of students who are interested in the benefits of majors in both nutrition and public health. Therefore, it accommodates the interests of students who:

- plan a career in public health nutrition and want to acquire the knowledge and skills of the nutritionist and public health professional.
- plan a career in nutrition and want to acquire the knowledge and skills and the perspective of the public health professional.
- plan a career in public health and want to acquire the knowledge, skills and perspective of the nutritionist.

ADMISSION

Applicants for the MS-MPH program must make separate application to, and be competitively and independently accepted by, the Department of Nutrition for the MS, Department of Health and Exercise Sciences for the MPH, and the Public Health Academic Program committee.

Students who have been accepted by both departments may apply for approval to pursue the dual program anytime prior to, or after, matriculation in either or both departments. Such approval will be granted provided that dual program studies be started prior to entry into the fourth semester of the MS and MPH programs.

REQUIREMENTS

A dual degree candidate must satisfy the requirements for both the MS (public health nutrition concentration) and the MPH, as well as the requirements for the dual program. All candidates for the dual degree must successfully complete Health and Society (Public Health 555), two credits of Seminar in Public Health (Public Health 509), and a minimum of 60 credits. The Department of Nutrition will award a maximum of 11 semester hours of credit toward the MPH for successful completion of approved graduate level courses offered in the Department of Health and Exercise Science. The Department of Health and Exercise Science will award a maximum of 11 semester hours of credit toward the MS for successful completion of approved graduate level courses offered in the Department of Health and Exercise Science. All courses for which such cross-credit is awarded must be approved by the Public Health Academic Program Committee and the student’s graduate committee. A single block field experience (or public health internship) is required of all students and the analytical field paper incorporates public health nutrition and the student’s public health concentration.

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

APPROVED DUAL CREDIT

MS courses to be counted toward the MPH program must include 10 semester hours of Field Study in Community Nutrition (Nutrition 515) and 1 semester hour of Graduate Seminar in Public Health (Nutrition 509). MPH courses to be counted toward the MS include Public Health Administration (Public Health 520), Biostatistics (Public Health 530), and Epidemiology (Public Health 540).

DOCTOR OF PHILOSOPHY

Human Ecology Major • Nutrition Science Concentration

The PhD enables students to study the science of nutrition from the cellular/molecular level to the application of nutrition principles by people in a changing environment.

The doctoral program emphasizes cellular/molecular nutrition, human nutrition, nutritional epidemiology, and experimental nutrition. Cognate areas may include anthropology, biochemistry, chemistry, communications, education, food technology, human development, physiology, public health, sociology, statistics, and/or toxicology.

REQUIREMENTS

- Sixteen hours in nutrition including 4 hours at the 600 level (exclusive of dissertation).
- Nutrition 511, 512, 541, and 2 hours from either 542-544.
- 4 hours of Nutrition 540, attendance required every semester.
- 6 hours of statistics.
- 6 hours in a cognate area.
- 9 hours at the 600 level.
- Students without college teaching experience are required to take the fall semester teaching seminar for GTAs and Nutrition 548 comprising a faculty-supervised problem in college teaching.

Nutrition Minor

The graduate minor consists of Nutrition 511 and 512 plus at least three hours from any letter-graded 500-level or above nutrition courses.

GRADUATE COURSES

Nutrition (726)

500 Thesis (1-15) P/NP only.
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. Satisfactory/No Credit grading only.
508 Culture, Food, and Nutrition (3) Food-related behavior of individuals and groups in United States. Sociocultural, economic, and technological influences. Nutrition and food surveys, public policy. Prereq: Advanced Nutrition or consent of instructor.
509 Graduate Seminar in Public Health (1) (Same as Exercise Science 509; Public Health 509; Nursing 509; Social Work 509.)
511 Advances in Carbohydrate, Lipid and Protein Metabolism (4) The physiological impact of dietary carbohydrates, lipids and proteins, with an emphasis on nutritional and hormonal regulation of intermediary metabolism, bioenergetics and gene regulation. Prereq: Advanced Nutrition course.
512 Advances in Vitamin and Mineral Metabolism (3) Advances in the requirements, utilization, metabolism and physiological impact of micronutrients with an emphasis on vitamins and minerals in the context of human nutrition. Prereq: Advanced Nutrition course.

513 Community Nutrition I (3) Orientation to community; assessment of nutrition problems, needs, and resources; functional roles of public health nutritionist. Concurrent field experiences. Prereq: Advanced Nutrition or consent of instructor.

514 Community Nutrition II (3) Planning, implementation, and evaluation of public health nutrition programs. Concurrent field experiences. Prereq: 513 or consent of instructor.

515 Field Study in Community Nutrition (1-12) Personal participation in and analysis of state or regional community nutrition program. Location of in-depth study to be selected in consultation with instructor. Prereq: 513, 514 and consent of instructor. Satisfactory/No Credit grading only.

516 Maternal and Child Nutrition (3) Nutrition principles related to growth and development during pregnancy, infancy, and childhood to age 5; high risk conditions. Prereq: Advanced Nutrition or consent of instructor.

517 Childhood and Adolescent Nutrition (3) Application of nutrition principles to school age children; effects of diseases on growth and health maintenance; nutritional assessment and counseling for nutrition. Prereq: Advanced Nutrition or consent of instructor.

518 Nutrition and Aging (3) Nutritional problems of adults; nutritional requirements, dietary intakes; effects of nutrition on biological aging. Prereq: Advanced Nutrition or consent of instructor.

520 Nutritional Ecology (2) Examination of issues in natural, political, physical, and social environments that impact availability of food and nutrients in U.S. food supply.

521 Physiological Basis for Diet and Disease (3) Altered nutrient needs as result of metabolic changes that occur in selected disease states. Prereq: Nutrition in Disease or consent of instructor.

522 Nutrition Counseling (2) Individual eating habits and disorders, evaluation strategies for effectiveness of helping process. Prereq: Nutrition in Disease or consent of instructor.

524 Nutrition Education: Principles, Implementation, and Evaluation (3) Conceptual models, principles, application, and evaluation models in nutrition education research. Prereq: 508 or consent of instructor.

530 Molecular Application in Nutrient-Gene Interaction I (1) Theories and applications of gene regulation methodologies. Experimentation with DNA and RNA. RNA and DNA isolation and analysis to illustrate nutrient regulation of gene expression. Combination of lab/lecture.

540 Seminar in Nutrition (1) May be repeated. Satisfactory/No Credit grading only.

541 Research Methods (2) Basic principles of planning, conducting, and interpreting nutrition and foodservice systems administration research. Prereq: 6 graduate hours in nutrition and food system administration and statistics.

542 Advanced Experimental Nutrition (2) Application of research principles to individual project using experimental animals. Prereq or coreq: 541.

544 Survey Methods in Food and Nutrition (2) Application of survey research methods to nutrition projects: assessment of food consumption, nutrient intake, nutritional status, sociocultural-economic parameters, food production and service. Prereq or coreq: 541.

547 Field Experience (3-9) Experience in food-related industry or agency under supervision of faculty member. Prereq: Consent of instructor. Satisfactory/No Credit grading only.

548 Directed Study in Nutrition (1-3) Advanced study in nutrition. Prereq: Consent of instructor. May be repeated. Maximum 6 hours.

549 Special Topics (1-3) Recent advances in nutrition or food systems administration. Prereq: Consent of instructor. May be repeated. Maximum 6 hours.

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

602 Advanced Topics in Nutrition Science (1-3) Comprehensive individual study and group discussion of topics related to current problems in nutrition. Prereq: 512 or consent of instructor. May be repeated.

603 Current Trends in Food and Sociocultural Change (2) Critical evaluation of research. Prereq: 508 or consent of instructor.

Department of SPORT AND LEISURE STUDIES

http://web.utk.edu/~sals/

DeSensi, J.T., Head

Professors
DeSensi, J.T., EdD ........................................ North Carolina (Greensboro)
Hayes, G.A., PhD ........................................ North Texas State
Wrisberg, C.A., PhD .................................  Michigan

Associate Professors
Jones, R.E., PhD ........................................... Toledo
Kelley, D.R., PhD ....................................... Georgia State
Krick, K.L., ReD ........................................ Indiana

Assistant Professors
Faulbrother, J., PhD ...................................... Florida State
Fisher, L.A., PhD .......................................... Berkley
Hardin, R.L., PhD ........................................ Tennessee
McCutchen, M.G., EdD ............................... North Carolina (Greensboro)
Stratta, T.M., PhD ....................................... Southern Illinois

Adjunct Faculty
Avery, K., MS ............................................. Tennessee
Bemiller, J., JD ........................................... Tennessee
Bletner, J., MS ............................................. Ohio University
Brown, M., MS ............................................ Tennessee
Carignani, E., MS ....................................... Tennessee
Cronan, J., MS .......................................... Louisiana State
Denton, H., MS ........................................... Tennessee
Irwin, T., JD .............................................. Tennessee
Myers, W., MS ........................................... Tennessee
Schleisman, E., PhD .................................... Tennessee
Schmidt, W., MS ...................................... Tennessee
Summitt, P., MS ......................................... Tennessee
Tegano, C., EdD ........................................ Virginia Tech
Thomas, D., MS ........................................ Tennessee
White, K., BS ............................................. Tennessee
Whitney, J., PhD ....................................... Tennessee

Internship Coordinator
Brown, L.Y., MS ........................................ Tennessee

Lecturers
Brown, L.Y., MS ........................................ Tennessee
Causey, S., MS ........................................... Tennessee
Dooley, T., MS ........................................... Tennessee
Hood, G., PhD ........................................... Tennessee
Jennings, D., BS ......................................... Tennessee
Lambert, J., MS ........................................ Baptist Theological Seminary
Walczyk, J., MS ......................................... Old Dominion

Artists in Residence—Dance
Burke, P.

MAJORS DEGREES

Recreation and Leisure Studies .................................................. MS
Sport Studies ............................................................................ MS
Education ................................................................................ PhD

The Department of Sport and Leisure Studies is committed to excellence in research, teaching, practice, and service within the multifaceted contexts of sport, leisure, and recreation. We are dedicated to providing superior and innovative programs of study and applied experiences that will enable students to become effective and imaginative professionals, scholars, and citizens. The department is also committed to the principles of diversity and social justice and to the provision of positive sport and leisure experiences for all people.

The Department of Sport and Leisure Studies offers graduate programs leading to degrees, majors and concentrations in:
Master of Science
Recreation and leisure studies major
Recreation and leisure administration concentration
Therapeutic recreation concentration
Sport studies major
Sport management concentration
Sport studies concentration

Doctor of Philosophy
Education major
Sport studies concentration

MASTER OF SCIENCE
Recreation and Leisure Studies Major

REQUIREMENTS
Requirements for concentrations appear below.

Recreation and Leisure Studies Major • Recreation and Leisure Administration Concentration (Thesis Option)

<table>
<thead>
<tr>
<th>Hours Credit</th>
<th>Recreation and Leisure Studies 415</th>
<th>Recreation and Leisure Studies 510</th>
<th>Recreation and Leisure Studies 515</th>
<th>Recreation and Leisure Studies 540</th>
<th>Recreation and Leisure Studies 541</th>
<th>Safety 443 or Sport Management 512</th>
<th>Statistics</th>
<th>Research Methods</th>
<th>Thesis</th>
<th>Recreation and Leisure Studies 590 Graduate Internship</th>
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Total 33

Recreation and Leisure Studies Major • Recreation and Leisure Administration Concentration (Non-Thesis Option)

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Total 36

Recreation and Leisure Studies Major • Therapeutic Recreation Concentration (Thesis Option)

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Total 33

Recreation and Leisure Studies Major • Therapeutic Recreation Concentration (Non-Thesis Option)

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Total 36

*Must meet national certification requirements

MASTER OF SCIENCE
Sport Studies Major

Graduate Assistantships
Graduate assistantships are available to qualified candidates. Students should contact directly the area in which they are pursuing an assistantship. A limited number of graduate teaching assistantships are available in the Physical Education and Activity Program for sport management students. Please contact Glenda Dills at gdills@utk.edu or 865-974-1272 for more information regarding these assistantships.

Sport Management Concentration
The sport management concentration provides the opportunity for students to have a quality academic experience and to gain professional experience as they prepare for careers in the sports industry.

REQUIREMENTS

Sport Studies Major • Sport Management Concentration (Project Option)

<table>
<thead>
<tr>
<th>Hours Credit</th>
<th>Sport Management 511</th>
<th>Sport Management 532</th>
<th>Sport Management 535</th>
<th>Sport Management Electives</th>
<th>Cultural Foundations of Sport</th>
<th>Electives</th>
<th>Sport Management 501–Project</th>
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Total 33

Sport Studies Major • Sport Management Concentration (Thesis Option)

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<th>Hours Credit</th>
<th>Sport Management 511</th>
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<th>Sport Management 535</th>
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Total 30

1Sport Management 440, 512, 530, 540, 544, 553, 554, 555, 570, 580.
2Sport Studies 507, 514, 542.
3These courses can be taken within Sport and Leisure Studies or outside the department.
A total of six hours may be earned in Sport Management 590 and 595 combined.
Sports Studies Concentration

REQUIREMENTS

Thesis and Non-Thesis Options

The thesis option is available for all students and is especially encouraged for those who intend to eventually pursue a doctoral degree. All thesis students are required to register for 6 hours of thesis (Sport Studies 500). Students who choose the non-thesis option are required to take a written comprehensive examination.

All students must complete a minimum of 30 semester hours and are required to take either two semesters (1 hour each) of Cultural Studies in Education Seminar (Cultural Studies in Education 590) or Justice, Schools, and Sports (3 hours—Cultural Studies in Education 592). Students must select a minimum of 15 hours from the following Sport Studies courses: Sport Studies 505, 507, 514, 533, 534, 535, *537 (1), 542, 543, *593 (1-3), *594 (1-3), *595 (1-3), *633. Students may select additional courses relevant to their professional and career goals from other departments.

DOCTOR OF PHILOSOPHY

Education Major • Sport Studies Concentration

The PhD with a major in education offers a concentration in sport studies with areas of specialization in sport sociology and sport psychology. The program stresses an interdisciplinary approach to course work and research and expects its students to become proficient in qualitative and quantitative research methods. Students are expected to obtain a significant grounding in the allied, parent disciplines. The program prepares students to teach in higher education and/or to conduct work within applied educational and sport settings.

REQUIREMENTS

The program usually takes 3 years (2 years of coursework and year for the dissertation) and includes 15 credits in the concentration, 15 credits in research, 11 core credits, 9 credits in a specialization, 6 credits in a cognate area, and 24 dissertation credits.

GRADUATE COURSES

Dance (274)

415 Teaching Creative Dance for Children (2) Theory, methods, materials and practical experience in presentation and integration of creative dance in grades K-6. Mini-teaching experience.

480 Dance Through the 19th Century (3) Dance of various societies and culture from pre-history through 19th century.

490 Dance in the 20th Century (3) History and philosophy of dance.

495 Dance Pedagogy (3) Principles and methods of teaching dance with practical application in mini-teaching experience. Prereq: Upper-class or graduate standing and consent of instructor. Different level of performance is expected of those registered for graduate credit.

510 Ballet: Level IV (2) Instruction and practice in advanced classical ballet techniques. Prereq: Consent of instructor. May be repeated. Maximum 8 hours.

520 Jazz: Level IV (2) Instruction and practice in advanced jazz styles and techniques. Prereq: Consent of instructor. May be repeated. Maximum 8 hours.

530 Modern: Level IV (2) Instruction and practice in advanced modern dance techniques. Prereq: Consent of instructor. May be repeated. Maximum 8 hours.

550 Dance Composition IV (3) Independent study applying choreographic and production skills, culminating in presentation of two works. Prereq: 440 Composition I and 445 Composition II or consent of instructor.

593 Independent Study (1-3) May be repeated. Satisfactory/No Credit or letter grade.

Recreation and Leisure Studies (853)

415 Development and Maintenance of Recreation and Athletic Facilities (3) Principles of designing, planning, equipping, operating and maintaining various facilities. Elements of risk management and safety in design process. Prereq: 310, Sport Management 350, or consent of instructor. (Same as Sport Management 415.)

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 Sport Management 350.

440 Dimensions of Commercial Recreation and Leisure Enterprises (3) Prereq: 201, junior standing or consent of instructor.

450 Special Topics in Leisure Education (1-6) Development of special topics in recreation, therapeutic recreation and leisure. May be repeated. Maximum 6 hours.

470 Tourism and Leisure Industries (3) Symbiotic relationship between tourism and various sectors of leisure industry. Use of resources, both natural and developed, and economic impacts of ventures. Sociocultural impacts on venue as well as venues impact on local population.

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

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. Satisfactory/No Credit grading only.

510 Trends and Issues in Service Management (3) (Same as Hotel, Restaurant, and Tourism 510.)

515 Philosophical and Conceptual Foundations of Leisure (3) Philosophy of leisure and recreation; nature of philosophy, concepts of leisure, recreation, play, work, and other factors, history of field, and relationship of ideas to contemporary society and to professional practice.

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

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

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

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.

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

590 Graduate Internship (3-6) Required of all graduate students. Application of previous theoretical and applied knowledge and skills in an appropriate recreation/leisure setting. The internship is intended to simulate a full time professional level work experience during the entire semester. Therapeutic Recreation Internship must meet NCTRC national guidelines. Prereq: Completion of 24 graduate hours/ 3.0 GPA and/or permission of instructor.

591 Directed Study in Leisure and Recreation (1-6) Detailed study of theme, issue, or concern. Designed to meet needs of individual students. May be repeated. Maximum 6 hours.

592 Special Topics in Recreation and Leisure Studies (1-6) May be repeated. Maximum 6 hours.
Sport Management (957)
415 Development and Maintenance of Recreation, Tourism and Athletic Facilities (3) (Same as Recreation and Leisure Studies 415.)
440 Sport Marketing (3) Application of fundamental marketing concepts to sport industry. Marketing research, promotions, fund raising, advertising, and assessment of marketing programs specific to sport. Historical development of sport marketing. Prereq: Marketing 300 and progression to Sport Management.
460 Development and Revenue Generation in Sport (3) Designed to provide overview of theories, strategies, and techniques used in the production of revenue for sport organizations and through sporting events. Emphasis on developing balanced, multifaceted programs that target a variety of constituencies in the sport industry.
500 Thesis (1-15) P/NP only.
501 Special Project (3) Culminating experience for non-thesis major. Research study suitable for publication, or practicum requiring special written work. Prereq: 532.
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. Satisfactory/No Credit or letter grade.
503 Problems in Lieu of Thesis (2-3) May be repeated. Maximum 9 hours. Satisfactory/No Credit grading only.
511 Administration/Supervision In Sport (3) Development of knowledge and analytic skills desirable for managers/administrators in sport business/organization: organizational, administrative, and supervisory strategies related to sport in profit and non-profit settings.
512 Application of Legal Concepts to Sport Settings (3) Application of contract law, breach of contract, and monetary damages within sport settings: risk assessment and development of effective risk management strategies; development of contracts in sports; and analysis of cases involving discrimination based upon gender, race, and age as well as protection of rights at amateur and professional levels of sport.
530 Sport and Media Issues (3) Gender and race issues within context of media and sport. Development of sport media and media influence on sport.
532 Research Techniques in Sport (3) Evaluate, compare, and contrast research techniques in sport with consideration for and experiences in appropriate review, design, analysis procedures, and proposal development.
535 Ethics in Sport Management (3) Development of analytical skills and knowledge desirable of middle and upper level managers in sport business/organizations. Social issues and ethics in sport administration.
540 Sport Economics and Finance (3) Principles of economics and finance as applied to sport organizations. Market structures of sport finance and political economics that form those structures.
544 Theories of Leadership and Leader Behavior in Sport (3) Integration of various theoretical approaches to leadership styles in sport administration within cultural contexts, research, and field experiences.
553 Case Studies in Sport Management (3) Current issues and problems in sport administration at all levels of amateur and professional sport. May be repeated under different topic. Maximum 9 hours.
554 Readings in Sport Management (3) Survey of pertinent literature in refereed and applied journals and texts.
555 Evaluation Techniques for Sport Managers (3) Review and application of techniques of evaluation appropriate for sport programs, facilities, and personnel.
570 Event Management (3) Review of current research related to theory and practice in event management and involvement in management capacity with one or more special events.
575 Seminar in Sport Management (1) Selected topics in sport management. May be repeated with consent of instructor. Maximum 3 hours. Satisfactory/No Credit grading only.
580 Special Topics (1-3) Advanced study in selected disciplinary or professional areas of physical education and/or sport. May be repeated. Maximum 6 hours. Satisfactory/No Credit grading only.
590 Practicum (3) Practical experience in areas of major interest. May be repeated. Maximum 6 hours. Satisfactory/No Credit grading only.
593 Independent Study (1-3) May be repeated. Letter grade only.
595 Internship (3) Full-time application of previous theoretical and applied knowledge and skills in appropriate sport setting. Satisfactory/No Credit grading only.

Sport Studies (959)
500 Thesis (1-15) P/NP only.
501 Special Project (3) Research study suitable for publication, or practicum requiring special written work.
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. Satisfactory/No Credit grading only.
505 History of Olympics: Ancient and Modern (3) Examination of various aspects of ancient and modern Games. Ancient Olympics 776 BC to 393 AD: Panhellenic Games. Modern Olympics, 1896 to date: political, social class, gender, and economic issues that influence Games.
514 Advanced Philosophy of Sport (3) Major philosophical theories of sport. Various conceptual, moral, aesthetic, and social-political issues.
515 Social Theories of Sport (3) Liberal, democratic and Marxist social theories of sport.
533 Psychology of Sport (3) Social psychological factors influencing human behavior in a sport context; discussion of contemporary theory, research, and methodology. Prereq: General psychology course or consent of instructor.
534 Motor Behavior and Skill Acquisition (3) Topical explanation and application of principles of human movement behavior to acquisition and performance of skills; discussion of current research and methodology.
535 Health and Exercise Psychology (3) Study and cultural critique of various aspects of health and exercise psychology.
536 Expert Performance in Sports (3) Examines expertise in athletic performance with a primary focus on the development and maintenance of expertise. Special emphasis is placed on theoretical and practical perspectives on the study of sport expertise as they intersect with issues regarding sport psychology, race, aging, gender, or other socio-cultural factors.
537 Sport Psychology Seminar (1) Issues and problems in applied sport psychology. Analysis and synthesis of research literature and discussion of sport psychology consultation practices and other topics. May be repeated. Maximum 3 hours. Satisfactory/No Credit grading only.
539 Research Development in Sport Psychology: Idea Formation to Data Collection (3) First of a two-semester sequence designed to familiarize students with research process in applied sport psychology. Includes idea formation, critical review of related literature, development of a research question and methodology, and data collection.
540 Research Development in Sport Psychology: Data Analysis to Manuscript Submission (3) Second of a two-semester sequence designed to familiarize students with research process in applied sport psychology. Includes data analysis, manuscript preparation and manuscript submission.
542 Sociological Aspects of Sport (3) Social and cultural factors influencing sport and physical education. Pertinent issues and research applications. Prereq: Consent of instructor.
543 Women, Sport, and Culture (3) Critical examination of experiences of girls/women in American sports from a socio-cultural perspective with particular emphasis on the constructs of gender, race, class, and sexuality. Explores theories from sport, feminist, race, and cultural studies.
593 Independent Study (1-3) May be repeated. Satisfactory/No Credit or letter grade.
594 Supervised Readings (1-3) May be repeated. Satisfactory/No Credit or letter grade.
595 Special Topics (1-3) Advanced study in selected aspects of sport studies. May be repeated. Maximum 9 hours. Satisfactory/No Credit or letter grade.
600 Doctoral Research and Dissertation (3-15) P/NP only.
633 Advanced Sport Psychology (3) Analysis, synthesis, and discussion of contemporary theory and topics; research development and production in sport psychology. May be repeated. Maximum 9 hours.
681 Practicum (1-3) Intern experience in areas of major interest. May be repeated.
693 Independent Study (1-3) May be repeated. Satisfactory/No Credit or letter grade.
694 Supervised Reading (1-3) May be repeated. Satisfactory/No Credit or letter grade.
695 Special Topics (1-3) Study for doctoral students in selected aspects of sport studies. May be repeated. Maximum 9 hours. Satisfactory/No Credit or letter grade.
Department of
THEORY AND PRACTICE IN TEACHER EDUCATION

http://web.utk.edu/~tp/te/

Susan M. Benner, Head
Charles H. Hargis, Graduate Liaison

Professors

Benner, S., EdD .............................................. Columbia
Davis-Wiley, P., EdD ...................................... Houston
Hargis, C., EdD .............................................. Colorado State
Hatch, J., PhD .............................................. Florida
Hipple, T., PhD ............................................. Illinois
Jost, K., EdD ................................................. Oklahoma
Knight, L., PhD ............................................. Texas
Long, V., EdD .............................................. Missouri (Columbia)
Rowell, C., EdD ........................................... George Peabody
Turner, T., EdD ............................................. Penn State

Associate Professors

Ashmore, D., MS .......................................... Tennessee
Barclay-McLaughlin, M., PhD ......................... Michigan
Bentley, M., EdD .......................................... Virginia
Cagle, L., EdD .............................................. Georgia
Davis, J., PhD .............................................. New Mexico
Gilrane, C., PhD .......................................... Illinois
Hannum, J., EdD ......................................... Northern Colorado
Judge, S., EdD ............................................ California (Santa Barbara)
Melear, C., PhD .......................................... Ohio State
Puckett, K., PhD .......................................... Tennessee
Warden, K., PhD ......................................... Tennessee

Assistant Professors

Bell, S., PhD ............................................... Tennessee
Brommel, A., PhD .......................................... Southern Illinois
Brown, C., PhD ........................................... George Washington
Hendricks, D., PhD ....................................... Alabama
Rearden, K., PhD ......................................... Texas A&M
Scherff, E., PhD .......................................... Florida State
Taylor, M., PhD .......................................... Missouri
Wooten, D., PhD ......................................... New York

MAJORS DEGREES

Education ..................................................... PhD
Teacher Education ........................................ MS, EdS, EdD

The Department of Theory and Practice in Teacher Education offers graduate programs leading to degrees, majors, and concentrations in:

Master of Science

Teacher Education major

Track 1 (for previously licensed teachers - does not result in a teaching license)

Art education concentration
Early childhood special education concentration
Education of the deaf and hard of hearing concentration
Elementary education concentration
English education concentration
Foreign language/ESL education concentration
Mathematics education concentration
Modified and comprehensive special education concentration
Reading education concentration
Science education concentration
Social science education concentration

Track 2 (for individuals seeking an initial teaching license)

Art education concentration
Early childhood special education concentration
Education of the deaf and hard of hearing concentration
Elementary teaching concentration
Modified and comprehensive special education concentration
Secondary teaching concentration

Specialist in Education

Teacher education major

Elementary education concentration
English education concentration
Foreign language/ESL education concentration
Mathematics education concentration
Reading education concentration
Science education concentration
Social science education concentration

Doctor of Education

Teacher education major

Literacy, language and ESL education concentration
Teacher education concentration

Doctor of Philosophy

Education major

Early childhood education concentration
Literacy, language and ESL education concentration
Teacher education concentration

The College of Education, Health and Human Sciences offers the Master of Science, Specialist in Education, Doctor of Education, and Doctor of Philosophy degrees through the Department of Theory and Practice in Teacher Education. The college also offers initial teacher licensure programs at the graduate level. The program features a professional year internship with accompanying coursework, which may lead to a master's degree with a major in teacher education.

The department also houses programs for students seeking licensure in early childhood, primary, and middle school education (grades K-8), reading endorsement, special education, secondary social studies, and licensure in the education of the deaf/hard of hearing. Early childhood licensure and degree programs are also available in the college. The department houses four program areas: education of the deaf/hard of hearing/educational interpreting; holistic/teaching/learning; content fields teaching; and urban/multicultural teacher education.

The deaf/hard of hearing/educational interpreting program area focuses on preparing teachers for deaf and hard of hearing children and youth pre-K-12. Preparation emphasizes the ability to teach children with a hearing loss using all modes of communication (e.g., aural/oral, sign systems, American Sign Language) and in residential or inclusive settings. Educational interpreting is a concentration under the undergraduate special education program. Courses are designed to prepare interpreters to work in mainstream (K-12) settings with deaf and hard of hearing students. Educational interpreters facilitate communication between deaf and hard of hearing students and other nonsigning members of the school community, including teachers and learning classmates.

The holistic teaching/learning area's central emphasis is on holistic, integrative, and interdisciplinary teaching/learning as opposed to teaching disciplinary subject content (e.g., science, mathematics, language arts) as separate entities. The focus on
integration is similar to how children learn and how language is central to the teaching/learning process. The faculty believes that students should be prepared as teachers who can facilitate learning rather than merely dispense content. Central to the philosophy of holistic teaching and learning is knowing each individual child’s learning skills, abilities, and interests. The holistic teaching/learning program area houses programs in elementary education, reading education, and special education.

The urban/multicultural teacher education area offers programs for students interested in teaching children of all ability levels in K-8 urban and multicultural settings. Faculty promotes innovation in education through alternative approaches to instructional delivery, curriculum development, assessment, and program evaluation. The area also provides preparation in early childhood special education for special educators working in classroom, home-based, and community settings.

The content fields teaching area’s mission is the preparation of teachers for instruction in art, ESL, English, foreign language, mathematics, social science and science. The emphasis is on how these disciplines are taught in context of different cultures.

For admission, most programs (except the Track 2 Initial Licensure/ Master of Science) require current scores from the GRE general section, and all require a departmental application form and letters of recommendation. For additional information about the various programs of study and admission, write to the Student Services Center in the College of Education, Health and Human Sciences, Claxton Complex A332. http://www.utk.edu/departments/advising.

MASTER OF SCIENCE
Teacher Education Major

The Master of Science with a major in teacher education has two tracks. Track 1 is intended for students who are licensed to teach art, English, elementary education, foreign language, mathematics, natural science, reading education, social science, early childhood special education, or education of the deaf and hard of hearing. (Non-licensed applicants to Track 1 will be reviewed on a case-by-case basis and must have a strong disciplinary background and professional goals, which can be fostered through participation in the non-licensure program.) Track 2 is designed for students seeking initial teacher licensure in one of the above fields.

Both Track 1 and Track 2 offer thesis and non-thesis options and require students to submit to a written comprehensive examination. In addition, students completing theses must sit for an oral examination on their thesis.

TEACHER EDUCATION MAJOR
TRACK 1: NON-LICENSURE CONCENTRATIONS

Art education
Early childhood special education
Education of the deaf and hard of hearing
Elementary education
English education
Foreign language/ESL education
Mathematics education
Modified and comprehensive special education
Reading education
Science education
Social science education

ADMISSION

- Hold a bachelor’s degree; minimum 2.80 GPA (3.0 in major).
- Hold a valid teaching license.
- Present acceptable scores on the Praxis II: National Teachers Examinations (information about these exams and exemptions to them is available in the College’s Student Services Center, A332 Claxton Complex).
- Submit a Post-Baccalaureate Teacher Education Program of Study (i.e., a written plan resulting from transcript analysis that addresses possible course deficiencies; see the College’s Student Services Center, A332 Claxton Complex).
- Post-baccalaureate candidates seeking to teach in a field apart from their undergraduate major must complete 30 semester hours, to include 15 at the 300 level or higher, in addition to the requirements described above.
- Enrollment may begin in any academic term after notification of admission by letter, both from the Office of Graduate Studies and the College of Education, Health, and Human Sciences.

REQUIREMENTS

- Meet each semester with a faculty advisor to assess progress and to discuss next semester courses.
- Admitted candidates will complete prescribed set of courses: Core Area—Education Foundations, Trends and Issues, Research (9 hours minimum); Major Area—Specialization Courses (12 hours minimum); and Related Studies—(6 hours minimum).
- Completion of thesis or non-thesis option

Thesis: 30 semester hours of education, satisfactory completion of written thesis, comprehensive written examination, and oral defense of thesis; 2/3 of total hours for MS must be 500-level or above.

Non-Thesis: 33 semester hours (36 semester hours for early childhood special education, modified and comprehensive special education and education of deaf and hard of hearing) and satisfactory completion of written comprehensive examination; 2/3 of total hours for MS must be 500 level or above.

Teacher Education Major · Art Education Concentration · Track 1

Advising Note for Thesis and Non-Thesis Options

- The Track 1 MS serves those students who have a BS, BA, or BFA and desire a master’s degree, but do not wish to pursue certification to teach art, or who already have certification to teach art and wish to pursue a master’s.
- An exhibition offered instead of a thesis toward graduation must be of work directed by art and art education faculty, and the artwork completed while pursuing the master’s degree; a written paper must accompany the exhibition. The paper includes: (a) philosophical statement; (b) process and media explanation (demonstration of knowledge); (c) compositional analysis of each work; and (d) how the work relates to one’s personal artist statement.
• For both tracks, a comprehensive written examination is required during the final semester of work. An oral exam is given over the thesis. Students are expected to read and meet requirements of the Graduate School with regard to admission applications, candidacy forms, scheduling comprehensive exam, as well as meeting all requirements regarding the courses in their graduate program.

**Art Education Concentration (Thesis Option) • Track 1**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>6</td>
</tr>
<tr>
<td>Concentration</td>
<td>18</td>
</tr>
<tr>
<td>Thesis: Theory and Practice in Teacher Education 500</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>30</strong></td>
</tr>
</tbody>
</table>

1. Theory and Practice in Teacher Education 517; Instructional Technology, Curriculum, and Education 580.
2. Art Education 510, 520, 530, 540; Art History 400 or 500 level (3); Art Studio 400 or 500 level (3).

**Art Education Concentration (Non-Thesis Option) • Track 1**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>6</td>
</tr>
<tr>
<td>Concentration</td>
<td>21</td>
</tr>
<tr>
<td>500-Level Electives</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>33</strong></td>
</tr>
</tbody>
</table>

1. Theory and Practice in Teacher Education 517; Instructional Technology, Curriculum, and Education 580.
2. Art Education 510, 520, 530, 540; Art History 400 or 500 level (3); Art Studio 400 or 500 level (3); Theory and Practice in Teacher Education 593 or 595.

**Content Fields Teaching • Track 1**

**Concentrations in English Education, English as a Second Language Education, Foreign Language Education, Mathematics Education, Science Education, Social Science Education**

Contact the department head for information on these concentrations.

**Early Childhood Special Education Concentration • Track 1**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audiology and Speech Pathology 563</td>
<td>3</td>
</tr>
<tr>
<td>Special Education 554</td>
<td>3</td>
</tr>
<tr>
<td>Elementary Education 566</td>
<td>3</td>
</tr>
<tr>
<td>Elementary Education 567</td>
<td>3</td>
</tr>
<tr>
<td>Special Education 568</td>
<td>3</td>
</tr>
<tr>
<td>Special Education 504</td>
<td>6</td>
</tr>
<tr>
<td>Child and Family Studies 530</td>
<td>3</td>
</tr>
<tr>
<td>Curriculum, Educational Research, and Evaluation 580 (other approved research design class may be substituted)</td>
<td>3</td>
</tr>
<tr>
<td>Electives Advisor approval required</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>36</strong></td>
</tr>
</tbody>
</table>

1. Special Education 587 or Theory and Practice in Teacher Education 517; Special Education 586, 590.
2. Select (with major advisor) from: affective motivational disorder (6-9); general special education (6-9); elementary education (6-9); reading education (6-9); cognitive education (6-9); gifted education (6-9); modified programs (6-12); comprehensive programs (6-12). Others by committee approval.
3. Coursework (24 hours); thesis (6 hours).

**Elementary Education Concentration (Thesis Option) • Track 1**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>9</td>
</tr>
<tr>
<td>Concentration</td>
<td>12</td>
</tr>
<tr>
<td>Related Studies</td>
<td>3</td>
</tr>
<tr>
<td>Thesis: Theory and Practice in Teacher Education 500</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>30</strong></td>
</tr>
</tbody>
</table>

1. Curriculum, Educational Research and Evaluation 580; Theory and Practice in Teacher Education 517; 3 hours determined by student and advisor.
2. Choose from at least three areas: reading education, language arts, education, mathematics education, science education, social studies education, elementary curriculum, middle school curriculum.
3. Determined by student and advisor.

**Elementary Education Concentration (Non-Thesis Option) • Track 1**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>9</td>
</tr>
<tr>
<td>Concentration</td>
<td>15</td>
</tr>
<tr>
<td>Related Studies</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>33</strong></td>
</tr>
</tbody>
</table>

1. Curriculum, Educational Research and Evaluation 580; Theory and Practice in Teacher Education 517; 6 hours determined by student and advisor.
2. Choose from at least three areas: reading education, language arts, education, mathematics education, science education, social studies education, elementary curriculum, middle school curriculum.
3. Determined by student and advisor.

**Modified and Comprehensive Special Education Concentration (Thesis Option) • Track 1**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>9</td>
</tr>
<tr>
<td>Concentration</td>
<td>15</td>
</tr>
<tr>
<td>Thesis: Theory and Practice in Teacher Education 500 (Thesis)</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>30</strong></td>
</tr>
</tbody>
</table>

1. Special Education 587 or Theory and Practice in Teacher Education 517; Special Education 586, 590.
2. Select (with major advisor) from: affective motivational disorder (6-9); general special education (6-9); elementary education (6-9); reading education (6-9); cognitive education (6-9); gifted education (6-9); modified programs (6-12); comprehensive programs (6-12). Others by committee approval.
3. Coursework (24 hours); thesis (6 hours).

**Modified and Comprehensive Special Education Concentration (Non-Thesis Option) • Track 1**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>9</td>
</tr>
<tr>
<td>Concentration</td>
<td>27</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>36</strong></td>
</tr>
</tbody>
</table>

1. Special Education 587 or Theory and Practice in Teacher Education 517; Special Education 586, 590.
2. Select (with major advisor) from: affective motivational disorder (6-9); general special education (6-9); elementary education (6-9); reading education (6-9); cognitive education (6-9); gifted education (6-9); modified programs (6-12); comprehensive programs (6-12). Others by committee approval.
3. Problem courses in lieu of thesis (30 hours); additional problem courses (6 hours); oral exams over problem courses.

**Education of the Deaf and Hard of Hearing Concentration • Track 1**

Contact the department head for information on this concentration.
**Reading Education Concentration (Thesis Option) • Track 1**

<table>
<thead>
<tr>
<th>Hours Credit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>9</td>
</tr>
<tr>
<td>Concentration (reading education courses)</td>
<td>12</td>
</tr>
<tr>
<td>Related Studies</td>
<td>3</td>
</tr>
<tr>
<td>Thesis: Theory and Practice in Teacher Education 500</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>30</strong></td>
</tr>
</tbody>
</table>

1. Core: Curriculum, Educational Research, and Evaluation 580; Theory and Practice in Teacher Education 517; 3 hours determined by student and advisor.
2. Choose 3 hours from: language arts education, English education, elementary curriculum, elementary education, middle school curriculum, special education, or educational psychology.

**Reading Education Concentration (Non-Thesis Option) • Track 1**

<table>
<thead>
<tr>
<th>Hours Credit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>9</td>
</tr>
<tr>
<td>Concentration (reading education courses)</td>
<td>12</td>
</tr>
<tr>
<td>Related Studies</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>33</strong></td>
</tr>
</tbody>
</table>

1. Core: Curriculum, Educational Research, and Evaluation 580; Theory and Practice in Teacher Education 517; 6 hours determined by student and advisor.
2. Choose 9 hours from: language arts education, English education, elementary curriculum, elementary education, middle school curriculum, special education, or educational psychology.

**TRACK 2: INITIAL LICENSURE PROGRAMS**

The Track 2 master’s is intended for individuals desiring to earn teacher licensure. Applicants to this program must first be admitted to teacher education and complete the equivalent of an undergraduate minor in either elementary, middle school, or secondary education. Post-baccalaureate students interested in seeking licensure in art education, special education, or in other fields that require students to earn an undergraduate major would be expected to complete an equivalent undergraduate program of study. Please refer to the catalog for complete details. Individuals are encouraged to contact the College’s Student Services Center, A332 Claxton Complex, for a diagnostic interview and to develop a tentative course of study and time line.

**REQUIREMENTS**

**Track 2 Common Course Requirements**

- Master’s Track 2 programs are 36 credit hour (non-thesis); 42 credit hour (thesis).
- Students, regardless of teaching area (e.g., elementary, secondary, etc.), complete a common, teacher licensure, core of 24 credit hours during the Professional Year (see below):

**Professional Year Courses (24 hours)**

Education 574 (2), 575 (12), 591 (4), and Specialty Studies (6).

**Additional Course Requirements (12 hours)**

- Art Education: Art Education 510, 520, 530, 540.
- Early Childhood Special Education: Special Education 554; Elementary Education 566, 567; Special Education 568.

**SPECIALIST IN EDUCATION**

**Teacher Education Major**

The Specialist in Education with a major in teacher education encompasses concentrations in:

- Elementary education
- English education
- Foreign language/ESL education
- Mathematics education
- Reading education
- Science education
- Social science education
- Special education

These concentrations require completion of a minimum of 30 hours of coursework beyond the major’s, including 6 hours in core courses, 18 hours in specialized courses, and 6 hours to be determined by the student’s committee. Both thesis and non-thesis options are available.

**REQUIREMENTS**

A master’s degree is required for admission; most programs in Theory and Practice in Teacher Education also require a minimum of three years of professional experience. The total EdS program involves a minimum of four semesters of study with no fewer than 60 semester hours of graduate credit beyond the baccalaureate, including research/thesis hours.

Education courses at the 400-level required for licensure are not eligible. At least 2/3 of semester hours accumulated in master’s and all of the last 30 semester hours of coursework must be in 500- or 600-level courses. The EdS thesis must be approved by the student’s committee prior to submission to the Office of Graduate Studies for final approval and acceptance. The student must register for thesis hours during this time.

<table>
<thead>
<tr>
<th>Hours Credit</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Area</td>
<td>6</td>
</tr>
<tr>
<td>Concentration Specialty Area Methods</td>
<td>12</td>
</tr>
<tr>
<td>Research</td>
<td>6</td>
</tr>
<tr>
<td>Related Studies</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total (Thesis and Non-Thesis)</strong></td>
<td><strong>30</strong></td>
</tr>
</tbody>
</table>

1. Must include one course from two of the following areas outside the concentration: curriculum or leadership; anthropological; historical, philosophical or social foundations; human growth and development; pre-K-14 teaching methodology; instructional technology.
DOCTOR OF EDUCATION

Teacher Education Major

The EdD program is offered with a major in teacher education and concentrations in the following areas:

- Literacy, language, and ESL education (literacy, English education, ESL education)
- Teacher education (elementary education, social science education, mathematics education, science education)

DOCTOR OF PHILOSOPHY

Education Major

Faculty from the department participate in the delivery of the PhD with a major in education. Concentrations and specializations are available in the following areas:

- Early childhood education (early childhood special education)
- Literacy, language, and ESL education (literacy, language education, ESL education)
- Teacher education (elementary education, mathematics education, science education)

Information on admission and common program of study elements (e.g., core courses, research courses, etc.) appear at the beginning of the College of Education, Health, and Human Sciences section of this catalog.

Education Major • Early Childhood Education Concentration

The following constitute the courses typically taken by students enrolled in the concentration.

- Early Childhood Education Concentration (minimum credits)
  Theory and Practice in Teacher Education 604, 610, 640, 679, 689, 693, 694, 695
  Special Education 620, 630
  Early Childhood Education 650
• Specialization: Early Childhood Special Education (minimum 9 credits)
  Early Childhood Education 554, 566, 567, 568
  Theory and Practice in Teacher Education 579, 593, 594, 595
  Special Education 504, 565, 575, 584

Education Major • Literacy, Language, and ESL Education Concentration
  and Teacher Education Concentration

Contact the department head for information.

GRADUATE CERTIFICATE IN URBAN EDUCATION

The Department of Theory and Practice in Teacher Education offers a graduate certificate in urban education for experienced urban teachers. A cohort group is competitively selected each year. Participants complete a 12-credit, four-course program of study over a two-year period. First-year courses are Theory and Practice in Teacher Education 595 and 540. Second-year courses are Theory and Practice in Teacher Education 595 and 550.

GRADUATE COURSES

Art Education (141)

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

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

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

540 Use and Construction of Instructional Materials for Teaching Art (3) Examination and construction of curriculum and instructional aids related to teaching strategies in art education.

Education of the Deaf and Hard of Hearing (285)

415 Language Development of Deaf/Hard of Hearing I (3) Language problems of hearing impaired contrasted with scope and sequence of normal language development. Formal linguistic systems used to describe language development problems.

416 Language Development of Deaf/Hard of Hearing II (3) Developmental and remedial systems of teaching language to hearing impaired children. Comprehension and production differences, idiomatic and figurative structures. Prereq: 415 or consent of instructor.

419 Speech Development of Deaf/Hard of Hearing (4) Theories of speech development, approaches in training perception and production of speech, and aural habilitation. Practicum experiences.

424 Nature of Hearing Impairments (3) Basic principles of audiology: anatomy and physiology of hearing; nature and causes of hearing loss; methods and instrumentation for assessment of hearing level; interpretation of audiologic services to medical and other rehabilitative disciplines.

425 Introduction to the Psychology and Education of the Deaf/Hard of Hearing (3) Primarily for those planning to teach hearing impaired. Overview of research related to psychology, social adjustment, communication methodology, language development and education of hearing impaired. Survey of literature. Visits to programs.

504 Clinical Experience in Teaching and Supervision of Exceptional Children (3-9) (Same as Special Education 504.)

599 Vocational Guidance and Career Planning With Hearing Impaired (3) Utilization of psychological, educational, social and vocational, diagnostic materials and resources appropriate for hearing impaired persons to provide guidance in career decisions and individualized rehabilitation plan.

523 Practicum with Deaf/Hard of Hearing (3) Receptive and expressive language capabilities of hearing impaired student. Designing, teaching, and post-testing unit of instruction for remediation of specific language errors.


529 Teaching Reading to Deaf/Hard of Hearing (3) Specific methods necessary to teach the prelingually hearing impaired student. Practice in preparation of developmentally appropriate reading materials. Methods which assist in integrating hearing impaired students in regular reading curricula and materials. Prereq: 415.

579 Special Topics (1-3) Prereq: Admission to graduate program. May be repeated. Maximum 9 hours. Satisfactory/No Credit or letter grade.

Educational Interpreting (287)

431-432 American Sign Language III, IV (3,3) Fluency of expressive and reception sign communication skills. Use of language in context. Grammatical structures of ASL and cultural implications of deaf community. Must be taken in sequence. Prereq for 431: 226 or consent of instructor. Prereq for 432: 431 or consent of instructor.

435 Linguistics of American Sign Language (3) Introduction to grammatical and linguistic structures of ASL. Language variations, discourse, bilingualism and language contact also covered in this course. Course conducted in ASL. Prereq: 431 or consent of instructor.

Elementary Education (322)

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

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.


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.

505 Elementary and Middle School Teaching Methods II (6) Applied methods of teaching reading, language arts, science, social studies and mathematics: accommodation strategies for students with diverse needs. Prereq: Elementary and Middle School Teaching Methods I. Coreq: 575.

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 hours. Satisfactory/No Credit grading only.

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


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.

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

529 Practicum in Diagnosis and Remediation of Difficulties in Learning Mathematics (3) Assessment and practicum experience with children having difficulties in learning elementary school mathematics. Prereq: 523 or consent of instructor.

550 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.
566 Curriculum for Early Childhood Education (K-3) (3) Theoretical foundations and current research in content and skill areas of curriculum for kindergarten-grade 3; application to local school setting. Prereq: Consent of instructor. May be repeated. Maximum 9 hours.

567 Application of Theory in Early Childhood Education (K-3) Principles and practices from selected theoretical orientations. Prereq: Course in early childhood education or consent of instructor. May be repeated. Maximum 6 hours.

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

606 Research in Elementary Education (3) Analysis of research in elementary education with application to classroom teaching. Prereq: Research course.

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 hours. Satisfactory/No Credit grading only.

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

English Education (340)


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

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.

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

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

521 Interdisciplinary Aesthetics (3) Discussions, visual and audio presentations concerned with aesthetic considerations of areas of study: geography, history, physics, literature, languages, music, visual arts and drama.

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

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

597 Teaching Drama Grades 7-13 (3) Strategies and materials for teaching creative dramatics, enacting and writing of plays, reading of scripts.

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

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

Foreign Language/ESL Education (394)

485 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.

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

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

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


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

687 Advanced Studies in Foreign Language Education (3) Research, curricula, assessment, trends and issues in foreign language education. Prereq: 587 or consent of instructor.

Mathematics Education (642)

485 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.

522 Programs and Materials in School Mathematics (3) Examination, development and use of materials for creating an active learning environment for learning mathematics for all ages. Prereq: 485, 530, 543, or equivalent.

530 Teaching Mathematics to Young Children: K-4 (3) Unit planning, daily planning, grouping and other strategies of teaching mathematics. For those with little preparation in teaching elementary school mathematics.

543 Teaching Mathematics in Middle School: 5-8 (3) Unit planning, daily planning, grouping and other strategies of teaching mathematics. For those with little preparation in teaching middle school mathematics.


581 Mathematics Curriculum (3) Past, present and future issues influencing mathematics curriculum in schools, elementary through college. Teacher’s role in curriculum development and implementation. Rationales for curriculum decisions. Prereq: 485, Elementary Education 505, or equivalent.

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 special projects. Prereq: 485 or equivalent.

622 Research Trends in Mathematics Teacher Education (3) Analysis of current research trends in mathematics teacher education and impact of such research on development of teachers both preservice and inservice. Prereq: Minimum 9 hours of 500-level Mathematics Education courses.

683 Advanced Studies in Mathematics Education (3) Analysis of current research in mathematics education and implications of research for classroom practice. Prereq: Two graduate courses in mathematics education.

Reading Education (847)

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

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.

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.

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

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

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

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

538 Practicum in Diagnosis of Reading Problems (3) 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: Course in diagnosis and correction of classroom reading problems or consent of instructor.
539 Practicum in Remediation of Reading Problems (3) Application of learning and teaching methodology in working with elementary and/or secondary school students on one-to-one or small group basis. Prereq: Course in diagnosis and correction of reading problems or consent of instructor.

540 Teaching the Struggling Adolescent Reader (3) Methods of teaching middle and high school students who do not have sufficient reading skill to successfully engage in required reading. Prereq: Course in reading education, or equivalent teaching experience, or consent of instructor.

554 Developmental Reading Practicum (3) Diagnosing and teaching children having developmental and corrective reading needs in regular classroom. Prereq: Course in diagnosis and correction of reading problems or consent of instructor.

602 Seminar in Reading Education (1-6) May be repeated. Maximum 6 hours.

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.

605 Organizing and Administering Reading Programs (3) Diagnosing and teaching children having developmental and corrective reading needs in the regular classroom. Prereq: Course in diagnosis and correction of reading problems or consent of instructor.

Science Education (899)

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


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.

565 Instructional Trends and Issues in Science Education (3) Analysis of current trends in science instruction, instructional issues facing elementary, secondary, and community college science teachers, and application of learning theory to teaching biological, physical, and environmental sciences. Prereq: 496 or equivalent.

572 Nature of Mathematics and Science Education (3) Teaching and assessment of mathematics and science based upon student conceptions of nature of mathematics and science.

596 Curriculum Trends in Science Education (3) Analysis of elementary and secondary projects for biological, physical, and environmental sciences. Impact of current learning theories on future curriculum development projects. Prereq: 496, or Early Childhood Education 422 or equivalent. Prereq or coreq: 565 or consent of instructor.


696 Research Trends in Science Education (3) Analysis of current research trends in science education and relationship of such trends within broader educational community. Prereq: 628.

Social Science Education (900)

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.

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.

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.


599 Seminar in Social Studies Education (3) Research, trends, and issues in secondary social studies.

621 Seminar in Social Studies Research and Theory (3) Status of research and theory. Needed research, related research from other fields, and application of research. Prereq: Recent course in teaching of social studies or consent of instructor.

Special Education (932)

419 Psychology and Education of Students with Mild Disabilities (6) Nature and characteristics of persons with mild handicaps and educational strategies appropriate for these persons. Prereq: 402 and admission to Teacher Education Program. Coreq: 419. Satisfactory/No Credit grading only.

420 Field Experience in Modified Programs (3) Practicum in teaching in modified programs: planning, developing, implementing and evaluating instruction. Prereq: 402 and admission to Teacher Education Program. Coreq: 419. Satisfactory/No Credit grading only.

431 Field Experience in Comprehensive Programs (3) Prereq: 402 and admission to Teacher Education Program. Coreq: 432. Satisfactory/No Credit grading only.

432 Psychology and Education of Students with Moderate/Severe Disabilities (6) Nature and characteristics of persons with moderate/severe disabilities and educational strategies appropriate for these persons. Prereq: 402 and admission to Teacher Education Program. Coreq: 431.

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

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

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

471 Early Childhood Special Education (3) Assessment, curriculum planning and development and teaching approaches used in early childhood special education. Prereq: Admission to teacher education.

504 Clinical Experience in Teaching and Supervision of Exceptional Children (3-9) Placement in educational settings. May be repeated. Maximum 9 hours. Satisfactory/No Credit or letter grade. (Same as Education of the Deaf and Hard of Hearing 504.)

506 Internships in Teaching in Special Education and Rehabilitation (3-15) Placement in professional settings in public schools or agencies under supervision of master practitioners. Enrollment limited to those in fifth-year program. Satisfactory/No Credit grading only.

553 Assessment of Exceptional Students (3) Current issues related to assessment; advanced study of evaluation models for special education; dynamic and other innovative assessment approaches; advanced study of application to educational programming; basic statistics and application in assessment.

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

555 Characteristics of Affective/Motivational Functioning in Children with Disabilities (3) Definition, methods, identification and symptoms of children with affective/motivational development in disabled youngsters. Comparison to normal development and that of children labeled disturbed or behavior disordered.

556 Instructional Systems for Affective/Motivational Education for Children with Disabilities (3) Educational strategies and models of instruction; simulation, demonstration, and media. Teaching techniques, materials, and teacher/pupil/family interactions. Therapeutic forms of education through art, music, role play, puppetry, bibliotherapy, and group interactions. Prereq or coreq: 555 or consent of instructor.

557 Positive Preventive Discipline (3) Instructional, classroom and preventive/proactive strategies for use in classroom which positively effects efficiency of classroom. Research on how curriculum can encourage appropriate interactions of children and youth. Prereq: Admission to graduate program.

558 Neuromuscular and Health Disorders: Educational Implications (3) Neurological impairments, physical disabilities and special health conditions, autism. Investigation of instructional techniques and adaptations.
564 Psychosocial Development of Gifted and Talented Children (3) Phenomena of talent development in context of home, school, and society. Implications of maladjustment. Practices for promoting social and emotional development. Prereq: 451 and 452 or equivalent or consent of instructor.

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

568 Early Childhood Special Education: Theories and Interventions (3) Theoretical perspectives of early childhood special education; exploration of programmatic models, family-focused concepts and curriculum development.

575 Creative Problem-Solving Strategies for Special Educators (3) Techniques for solving problems encountered by special educators in any setting.

586 Seminar in Research Techniques in Special Education (3) Evaluation of appropriate research methodologies with handicapped populations.


590 Application of Microcomputer Technology in Special Education and Vocational Rehabilitation (3) Application of microcomputer technology with all categories of exceptionalities and across all chronological and functioning age ranges. Microcomputer adaptive software, special switch access, authoring systems, telecommunication, and strategies for cognitive development.

620 Internship in Research in Special Education and Rehabilitation (3-9) Placement with professional engaged in theoretically-based research: public school, institutions, agencies or university settings. Prereq: 9 hours in statistical and research methods. May be repeated. Maximum 9 hours. Satisfactory/No Credit grading only.

630 Internship in Institutional Leadership in Special Education and Rehabilitation (3-9) Advanced level field experiences under supervision of practitioner. Prereq: Consent of instructor. May be repeated. Maximum 9 hours. Satisfactory/No Credit grading only.

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

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. Satisfactory/No Credit grading only.

503 Problems in Lieu of Thesis (2-3) May be repeated. Maximum 9 hours. Satisfactory/No Credit grading only.

517 Trends and Issues in Education (3) Examination of contemporary trends and issues in education.

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

526 Drama and Story Telling in Teaching (3) Use of techniques of drama and storytelling to improve impact of teaching and to teach more effectively. Prereq: Classroom experience or admission to teacher education program.

535 Inquiry Teaching and Learning (3) Use of children's and adolescent literature. Exploration of ways to create setting that invite learners to engage in inquiry learning and teaching.

540 Topics in Improvement of Instruction (1-3) Special conferences, workshops, and inservice programs. May be repeated. Maximum 6 hours. Satisfactory/No Credit or letter grade.

550 Action Research and Practical Inquiry in Education (3) Principles of action research and practical inquiry for practitioners in early childhood and school settings and methods for conducting such inquiries in professional role. Prereq: Admission to graduate program.

593 Independent Study (1-3) May be repeated. Satisfactory/No Credit or letter grade.

594 Supervised Readings (1-3) May be repeated. Satisfactory/No Credit or letter grade.

595 Special Topics (1-3) May be repeated. Satisfactory/No Credit or letter grade.

596 Clinical Experience in Assessment and Instruction (3) Academic remediation applied in lab/field setting; tasks related to teaching: assessment, preparation of lessons, and delivery of instruction. Coreq: 553. Satisfactory/No Credit or letter grade.

600 Doctoral Research and Dissertation (3-15) Prereq: Admission to Candidacy. P/NP only.

604 Trans-Departmental Seminar I (1) Introduction to doctoral programs in education: research requirements, academic integrity, the meaning of scholarship in academic and issues/problems in education. Prereq: Admission to a doctoral program or consent of doctoral program coordinator. May not be used to meet 600-level requirement. Satisfactory/No Credit grading only.

605 Trans-Departmental Seminar II (1) Seminar to prepare doctoral students for the final steps in completing a terminal degree including preparing for and completing qualifying exams, preparing a prospectus, and completing a dissertation. Prereq: 604. May not be used to meet 600-level requirement.

610 Internship in College Teaching and Supervision (3-9) Supervised practice in college teaching and supervision. Prereq: Admission to doctoral program or consent of instructor. May be repeated. Maximum 9 hours. Satisfactory/No Credit grading only.

617 Trends and Issues in Teacher Education—An Interdisciplinary Perspective (3) Current trends and issues in field of teacher education: elementary education, mathematics education, science education and social science education. Prereq: Admission to doctoral program or consent of instructor.

620 Research in Literacy, Language, and ESL Education (3) Recent trends and historical traditions in language and literacy research: analysis of nature of research methods used, questions asked and topics studied. Prereq: Admission to doctoral program or consent of instructor.


689 Internship (1-3) Experiences in application of principles and practices of curriculum development and instructional improvement. Prereq: Program prerequisites and consent of instructor. May be repeated. Maximum 9 hours. Satisfactory/No Credit grading only.

693 Independent Study (1-3) May be repeated. Satisfactory/No Credit or letter grade.

694 Supervised Reading (1-3) May be repeated. Satisfactory/No Credit or letter grade.

695 Special Topics (1-3) May be repeated. Satisfactory/No Credit or letter grade.
The college had its beginnings in the university when surveying was introduced into the curriculum in 1838. The first two professional degrees, Civil Engineer and Mining Engineer, were established in 1879 at the same time that the Board of Trustees authorized the establishment of a graduate school. Known as Mechanic Arts originally, Engineering became a college in 1904.

The purpose of the College of Engineering is to educate men and women to the high levels of research, technical competence, and social understanding that will enable them to fulfill their responsibilities as professional engineers.

Graduate programs of the College of Engineering provide opportunities for advanced study leading to the Master of Science and the Doctor of Philosophy degrees. For a listing, consult majors and degrees available on the Majors and Degree Programs chart.

Graduate Program at the UT Space Institute

At the University of Tennessee Space Institute near Tullahoma, graduate-level courses are offered in engineering fields such as aerospace, chemical engineering, electrical engineering, engineering science, industrial engineering including engineering management, materials science and engineering, mechanical engineering, and mathematics and physics. All programs lead to the Master of Science degree. Also, PhD programs are available in many of these fields. Information may be obtained from the Registrar, the University of Tennessee Space Institute, Tullahoma, Tennessee 37388.

Department of CHEMICAL ENGINEERING

http://www.che.utk.edu/

John R. Collier, Head
Paul D. Frymier, Graduate Liaison

Professors
Bienkowski, P.R., PhD .......................................................Purdue
Collier, J.R., PhD ...............................................................Case Institute of Technology
Counce, R.M., PhD ...............................................................Tennessee
Moore, C.F. (Distinguished Service Professor), PhD, PE ..........Louisiana State
Sheth, Atul C. (UTSI), PhD ..................................................Northwestern
Steele, W.V., PhD .............................................................Queens (Belfast)

Associate Professors
Bruns, D.D., PhD ..............................................................Houston
Edwards, B.J., PhD ............................................................Delaware
Frymier, P.D., PhD ............................................................Virginia
Petrovan, S. (Research) PhD .................................................Iasi Tech
Wang, T.W., PhD .............................................................Massachusetts Institute of Technology
Weber, F.E., PhD ..............................................................Minnesota

Assistant Professor
Keffer, D.J., PhD ...............................................................Minnesota
Graduate programs lead to the degrees of Master of Science and Doctor of Philosophy with a major in chemical engineering with concentrations in chemical engineering, chemical bioengineering, advanced control systems, and polymer science and engineering.

MAJOR DEGREES
Chemical Engineering ....................................................... MS, PhD

DOCTOR OF PHILOSOPHY
Chemical Engineering Major

Requirements

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.

Requirements

Department requirements consist of the satisfactory completion of:

- Graduate courses in chemical engineering, amounting to approximately 24 semester hours, at least 30 of which must be in 600 series courses.
- 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, mathematics, physics, and engineering.
- The comprehensive examination, consisting of a written part and an oral part. The written part covers thermodynamics, reactor analysis, and transport phenomena and separations.
- Active participation in graduate seminars conducted by the department. Resident students must register for Chemical Engineering 501 every semester offered.

Graduate Certificate in Maintenance and Reliability Engineering

The College of Engineering offers a graduate certificate in maintenance and reliability engineering. The program is designed primarily for part-time students in that several of the courses are available through distance education.

The 12-credit certificate is earned by completing 483 and 484, which are cross-listed among all participating departments in the College of Engineering, plus two elective courses selected from a list of courses provided by the participating departments. Currently, the available elective courses are Chemical Engineering 561, Industrial Engineering 516 and 591, Mechanical Engineering 534 and 599, Nuclear Engineering 579 and 585. The selection of elective courses is determined through an advising conference with each individual student, and is based on the student’s personal interests, academic background, and work experience. Applicants must meet the minimum criteria established by the Graduate Council.

Graduate Courses

Chemical Engineering (226)


477 Honors: Applied Process Automation Laboratory (3) Interfacing flexible batch continuous processes to automation systems. Top down analysis with bottom up implementation, hierarchical structures and object oriented concepts used to design automation solutions: human-machine-interfaces. Workstations with modern industrial equipment, interactive graphics and visualization environment. Prereq: 360, consent of instructor.
483 Introduction to Reliability Engineering (3) (Same as Industrial Engineering 483; Mechanical Engineering 483; Nuclear Engineering 483.)

484 Introduction to Maintenance Engineering (3) (Same as Industrial Engineering 484; Materials Science and Engineering 484; Mechanical Engineering 484; Nuclear Engineering 484.)

485 Hydrocarbon Processing (3) Chemical and physical properties of selected petroleum and those processes utilized in conversion of raw material into various fuels and selected chemical feedstocks. Prereq: 340, Chemistry 350-360.

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

501 Graduate Seminar (1) Prereq: Admission to graduate program. May be repeated. Satisfactory/No Credit grading only.

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. Satisfactory/No Credit grading only.

505 Engineering Analysis (3) Formulation and solution of problems in chemical engineering and materials areas, ordinal and partial differential equations; types of ODE, PDE and solution techniques; transform methods; conformal mapping; variational methods; introduction to numerical methods. (Same as Materials Science and Engineering 505.)

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

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


541 Polymer Rheology (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, mass transfer operations in packed towers and agitated vessels, membrane separations. Equilibrium stage concepts applied to mass transfer operation, emphasizing nonisothermal and multicomponent systems.

547 Transport Phenomena I (3) Unified treatment of momentum transport (fluid flow), energy transport (heat conduction, convection, and radiation) and mass transport (diffusion). Fundamental basis of transport phenomena and momentum transport: viscous, viscoelastic, and potential flows.

548 Transport Phenomena II (3) Unified treatment of momentum transport (fluid flow), energy transport (heat conduction, convection, and radiation) and mass transport (diffusion). Energy transport and mass transport in closed and flow systems, interrelationships between transport processes, and prediction of transport parameters.

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


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


581 Green Engineering (3) Principles and practical aspects of industrial waste minimization. Regulatory environment, waste minimization strategies, economic analysis, process safety, case study: analysis of alternative waste minimization/management technologies. Prereq: Graduate standing in engineering or consent of instructor. (Same as Engineering Science 585; Environmental Engineering 581.)

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

590 Special Topics in Chemical Engineering (3) May be repeated. Maximum 6 hours.

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

631 Advanced Topics in Statistical Thermodynamics and Molecular Dynamics (3) Statistical thermodynamics, molecular based computer simulations, Monte Carlo and molecular dynamic calculations; applications to supercritical fluids, macromolecules and biological systems. Prereq: 532.


642 Advanced Topics in Polymer Processing (3) (Same as Materials Science and Engineering 642.)

647 Advanced Transport Phenomena (3) Theory of mass, momentum, and energy transport in reactive and non-reactive systems. Formulation of transport models useful for application to analysis and design of separation processes, and chemical and biochemical reactors. Prereq: 505, 547.


661 Advanced Topics in Process Dynamics and Control (3) May be repeated. Maximum 6 hours.

675 Microbial Systems Analysis (3) Identification and analysis of complex microbial systems using perturbation-response methods. Structuring of important mechanistic processes, interactions, and regulation at several systems levels of reactions at macro, cellular, physiological and molecular. Experimental methods for data gathering, signal resolution and processing, mathematical signal analysis, model development (deterministic, stochastic, phenomenological), and utility and limitations of approach. Prereq: 575 or consent of instructor.

691 Advanced Topics in Chemical Engineering (3) May be repeated. Maximum 6 hours.

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**Department of CIVIL AND ENVIRONMENTAL ENGINEERING**

[http://www.engr.utk.edu/civil/](http://www.engr.utk.edu/civil/)

**Professors**

- Bennett, R.M., PhD, PE
- Burdette, E.G. (Fred N. Peebles Professor), PhD, PE
- Chatterjee, A., PhD, PE
- Davis, W.T., PhD
- Deatherage, J.H., PhD, PE
- Drumm, E.C. (Research Fellow), PhD, PE
- Goodpasture, D.W., PhD, PE
- Reed, G.D., PhD, PE
- Robinson, R.B. (Fisher Professor), PhD, PE
- Urbank, T., PhD, PE
- Wegmann, J., PhD

**Associate Professors**

- Cox, C.D., PhD, PE
- Han, L.D., PhD
- Miller, T.L., PhD
- Penamadu, D. (Research Fellow), PhD
- Robinson, K.G., PhD

**Assistant Professors**

- Chu, K.H., PhD, PE
- Gentry, R., PhD, PE
The Department of Civil and Environmental 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, waste management, and environmental risk assessment.

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.

**MASTER OF SCIENCE**

**Civil Engineering Major**

**REQUIREMENTS**

The Department of Civil and Environmental Engineering offers two options for the Master of Science with a major 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.

**MASTER OF SCIENCE**

**Environmental Engineering Major**

**REQUIREMENTS**

For the 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: Engineering Fundamentals 101, 102; Nuclear Engineering 203 or Mechanical Engineering 331; Basic Engineering 121, 131; Engineering Science and Mechanics 231; Statistics 251; Civil Engineering 390, 395, 380; Mathematics 141, 142, 231, 241; Chemistry 120, 130. In general, these must be completed with a B average before courses for graduate credit can be taken.

The Department of Civil and Environmental 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 15 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 a minimum of 9 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.

**DOCTOR OF PHILOSOPHY**

**Civil Engineering Major**

A graduate program leading to the Doctor of Philosophy is offered with a major in civil engineering. Specific departmental requirements for the PhD degree include the following:

- A minimum of 72 semester hours beyond the bachelor’s degree, exclusive of credit for the MS thesis. Of this number, a minimum of 24 semester hours in 600 Doctoral Research and Dissertation will be required.
- 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.
- 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.
- 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.
- Upon completion of at least one-half of all coursework, each student must pass a comprehensive examination.
- After completion of the dissertation, prior to graduation, each student must pass a comprehensive examination administered by a faculty committee.

**Environmental Policy Minor**

The department participates in a program designed to give graduate students an opportunity to develop an interdisciplinary specialization in environmental policy. See Department of Economics for program description.
GRADUATE COURSES

Civil Engineering (234)

421 Portland Cement Concrete Mix Design and Analysis (3) Aggregate properties and tests, tests of Portland cement and concrete, mix design methods, admixtures, and nondestructive testing. 2 hours and 1 lab. Prereq: 321.

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 during 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, airfield capacity, geometrics and terminal layout and design. Railroad capacity, geometrics and system layout and design. Prereq: 210, 251, 352.

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) Design of continuous beams, floor slabs, and columns with combined axial loads and bending, footings; and design for torsion. Prereq: 471.

485 Principles of Hydrogeology (3) (Same as Geology 485).

490 Water Resources Engineering (3) Application of hydrologic/hydraulic principles for development of water resource project design and management of water resources; assessment of environmental impacts to surface water and groundwater; regulatory framework for water supply and water quality. Prereq: 390, and 395 or 416.

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

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. Satisfactory/No Credit grading only.

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

521 Pavement Design (3) Empirical and theoretical based methods of pavement design and analysis, strengthening existing pavements, pavement distress and economical design and maintenance. Prereq: 321 and 330.

522 Advanced Mix Design and Analysis for Asphalt and Portland-Cement Concrete (3) Aggregate properties and tests, asphalt binder properties and tests, mix design methods for asphaltic mixtures, hot-mix asphalt (HMA) mixture production and construction, HMA mixture characterization and analysis, Portland-cement concrete (PCC) mix design, admixtures for PCC, special types of PCC, PCC production and construction. Prerequisites: 321.


532 Rock Mechanics and Rock Engineering (3) Engineering properties and characterization of rock and rock masses. Discontinuity analysis, stress and strain, keyblock theory. Applications to rock slopes, underground excavations, foundations and groundwater flow. Prereq: 330 or consent of instructor.

533 Advanced Laboratory and Insitu Testing of Soil (3) Instruments for measurement of electrical signals, static and dynamic transducers, data acquisition and control, insitu measurement of stress, pore pressure, deformation, load deformation behavior (seismic methods, static methods), advanced laboratory shear strength and compressibility testing. 2 hours and 1 lab. Prereq: 330.

534 Geological Engineering (3) Influence of geologic origin and history on engineering characteristics of rocks and soils; applications of geology in planning, design and construction of civil engineering projects. 2 hours and 1 lab. Prereq: 330.


538 Finite Element Applications in Geotechnical Engineering (3) Application of finite element method to typical problems in geotechnical engineering. Confined and unconfined flow through porous media; two-dimensional stress and strain; two-dimensional elements; representation of nonlinear soil behavior with elastic and elastic-plastic models. Prereq: Introduction to Soil Behavior and Matrix Computation or equivalent. Taught concurrently with 561. Students may not receive credit for both 538 and 561.

539 Geotechnology Seminar I (3) Seminar topics in geotechnical and geological engineering. Research contributions and case histories by graduate students and engineers and scientists from surrounding community. Prereq: Graduate standing and consent of advisor. May not apply toward degree. May be repeated. Satisfactory/No Credit grading only.

540 Construction Management I (3) Management and organization of heavy and building construction projects. Prereq: 442.

541 Construction Management II (3) Management organization of heavy and building construction projects. Prereq: 442.

543 Construction Estimating (3) Project costs, estimating and takeoff techniques, market cost conditions, and feasibility of design to cost. Prereq: 442.

551 Traffic Engineering-Characteristics (3) Driver-vehicle-roadway system; traffic flow modeling; elements of transportation/highway safety. Prereq: Graduate standing.

552 Traffic Engineering-Operations (3) Signs, signals and marketing; short-term operations; controllers; signal timing/phasing; one-way reversible flow; system operations; identification and correction of high-accident locations and system deficiencies. Prereq: 551 or 452.

553 Geometric Design and Layout of Roadways and Community Facilities (3) Functional and geometric design and rural and urban roads of all classes; subdivision layout; configuration of urban roads and rural class streets; techniques for access control; freeway interchanges and street intersections; and parking. Prereq: 451 or consent of instructor.

555 Public Transit Planning (3) Characteristics of transit modes—conventional and paratransit; operational design of transit services; route planning and scheduling; cost analysis; mode choice models; performance evaluation; transit surveys; organization and financing. Prereq: 554 or graduate standing.

556 Traffic Accident Reconstruction (3) Data collection and analysis as basis for accident prevention on control programs; roadside hardware design and crash testing. Prereq: 452 or graduate standing.

557 Transportation Planning and Operations with Micro-Computer Applications (3) Transportation system management techniques and application of micro-computers to analysis of transportation actions. Prereq: 551 and 556.

558 Planning and Transportation (3) Preparation of transportation as elements of comprehensive development plans. Analysis of relationship between various transportation modes and between transportation and other community features. Use of planning process to establish existing travel patterns, modeling of demand, proposing alternatives and evaluation. Prereq: Graduate standing. (Same as Planning 537.)

561 Finite Element Applications in Structural Engineering (3) Application of finite element method to typical problems in structural engineering. Truss, beam and plate elements; two-dimensional stress and strain; two-dimensional elements; representation of nonlinear material behavior with elastic and plastic models. Prereq: Structural Analysis and Matrix Computation or equivalent. Taught concurrently with 538. Students may not receive credit for both 538 and 561.

562 Structural Systems (3) Structural system analysis and design; dead, live, wind, and earthquake loads on buildings; vertical and lateral load resisting systems; use of computers in analysis and design. Prereq: 471.

563 Statically Indeterminate Structures (3) Elastic analysis of indeterminate articular and rigid frames with non-prismatic members using energy, slope deflection, and moment distribution methods; plastic analysis of rigid frame; and stability analysis of compression members and portal frames. Prereq: 361.

565 Structural Dynamics (3) Analysis of free and forced vibrations, and transient response of structures having many degrees of freedom; elastoplastic behavior considered for structural systems; earthquake design and response of structures. Prereq: 471.

571 Behavior of Steel Structures (3) Behavior of structural steel members due to static and fatigue loading; relation between research results and current specifications for design. Prereq: 471.
653 Pollutant Fate Modeling and Risk Assessment (3) Application of scientific principles concerning movement and fate of chemicals at interfaces of air, water, and earthen solids in environment. Methods of assessing risk posed by presence of those chemicals. Prereq: 551.

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

Department of
ELECTRICAL AND COMPUTER ENGINEERING

http://www.ece.utk.edu/

Samir El-Gazaly, Head
Jack S. Lawyer, Graduate Liaison

Professors
Abidi, M., PhD .........................................................Tennessee
Birdwell, J.D., PhD ..................................................Massachusetts Institute of Technology
Bomar, B.W. (UTSI), PhD ........................................Tennessee
Bouldin, D.W., PhD ....................................................Vanderbilt
El-Gazaly, S.M., PhD ..............................................Texas (Austin)
Pace, M.O., PhD, PE ..................................................Georgia Institute of Technology
Lawler, J.S., PhD .....................................................Michigan State
Pujol, S.A. (UTSI), PhD ..............................................Vanderbilt
Roberts, M.J., PhD ....................................................Tennessee
Roth, J.R., PhD .......................................................Cornell

Associate Professors
Crilly, P.B., PhD ....................................................New Mexico State
Islam, S.K., PhD .......................................................Connecticut
Fathy, A., PhD ..................................................Polytechnic Institute Of New York
Koch, D.B., PhD .........................................................Missouri (Rolla)
Smith, L.M. (UTSI), PhD ........................................Tennessee

Assistant Professors
Bialock, B.J., PhD ..................................................Georgia Institute of Technology
Chiasse, J.N., PhD ..................................................Minnesota
Djouadi, S. M., PhD ................................................McGill (Canada)
Elhanany, J., PhD ...................................................Ben-Gurion (Israel)
Howlader, M.M.K., PhD ........................................Virginia Tech
Ferdjallah, M., PhD ................................................movement, Texas (Austin)
Kong, S.G., PhD .....................................................UCLA
Peterson, G.D., DSc ................................................Washington University
Qi, H., PhD ...........................................................North Carolina State
Tolbert, L.M., PhD ..................................................Georgia Institute of Technology

Emeriti Faculty
Alexeff, I., PhD, PE ..................................................Wisconsin
Gonzale, R.C., PhD ................................................Florida
Green, W.L., PhD ..................................................Texas A&M

MAJOR DEGREES
Electrical Engineering .........................................MS, PhD

The Department of Electrical and Computer Engineering offers graduate programs leading to the Master of Science and Doctor of Philosophy with a major in electrical engineering and concentrations in circuit theory, communication theory, computers, control systems, electro-optics, electromagnetic theory, plasma engineering, power electronics, and power systems.

Graduate students are able to conduct research in a wide variety of areas of electrical and computer engineering including: communications, electromagnetics, robotics, intelligent control, mixed-signal electronics, microelectronics, plasma engineering, power electronics and systems, electric power systems, computer architecture, networks, image processing, computer vision, VLSI system design, embedded systems, data fusion, data visualization, data structures and information systems.

The Departmental Graduate Committee is responsible for administering, promoting, and advancing the general well-being of the graduate program. Departmental actions regarding a graduate student may be appealed in writing, first to the departmental graduate committee and then to the department faculty.

MASTER OF SCIENCE
Electrical Engineering Major

Graduate work leading to the Master of Science with a major in electrical engineering may be completed during three semesters of full-time study, or two to three years of part-time study.

ADMISSION

Applicants for admission to the MS degree program are expected to have completed a bachelor’s degree in electrical engineering or computer engineering with an average of at least 3.0 out of 4.0 both overall and in the senior year. In addition, all applicants are required to submit scores from the General Graduate Record Exam (GRE). Applicants whose native language is not English, including those who have earned degrees at U.S. institutions must score at least 213 on the computer-based TOEFL exam or 550 on the written exam to be considered for admission to the program.

Applicants who hold the bachelor’s degree in other fields of engineering, computer science, mathematics, or the physical sciences 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. The department will require that selected undergraduate courses be taken as determined by the applicant’s prior education and experience. The student will be admitted under non-degree status until the required undergraduate courses are successfully completed with a 3.0 average.

REQUIREMENTS

Students may choose between a thesis option, a non-thesis course only option, and a non-thesis project option MS program. All students must file a Master’s Program Plan with the departmental graduate committee specifying which option they have selected, a semester-by-semester schedule of the courses they intend to take, and the members of the student’s master’s committee. Students may change between options one time by filing an amended Master’s Program Plan and with approval of the departmental graduate committee. A student who receives financial support under a research assistantship is enrolled in the thesis option by default. Students who have held a research assistantship will require approval from the departmental graduate committee to change to one of the non-thesis options.

Thesis Option

Specific requirements of the thesis option are a minimum of 30 semester hours including:

- Six semester hours of mathematics at the 400 level or above selected from a list approved by the graduate committee, or 6 semester hours of ECE courses at the 500 level or above, or 6 semester hours of non-ECE courses approved by the student’s master’s committee and the graduate committee.
- An additional 18 semester hours of 400-level or above work in electrical and computer engineering, with at least 6 hours of 500-level or 600-level work in each of two areas of electrical and computer engineering.
- Master’s thesis, totaling 6 semester hours.
- A final oral examination covering the thesis and related coursework.
Non-Thesis Courses Only Option

Specific requirements of the non-thesis courses only option are a minimum of 30 semester hours including:

- Six semester hours of mathematics at the 400 level* or above selected from a list approved by the graduate committee, or 6 semester hours of ECE courses at the 500 level or above, or 6 semester hours of non-ECE courses approved by the student’s master’s committee and the graduate committee.
- An additional 24 semester hours of 400-level* or above work in electrical engineering or computer engineering, with 18 of the hours at the 500-level or 600-level. Of the 18 hours required at the graduate level, at least 6 hours of work in each of two areas of electrical engineering or computer engineering and an additional 6 hours outside of the two areas.
- A final comprehensive written examination. This examination will be given in January and August.

Non-Thesis Project Option

Specific requirements of the non-thesis project option are a minimum of 30 semester hours including:

- Six semester hours of mathematics at the 400 level* or above selected from a list approved by the graduate committee, or 6 semester hours of ECE courses at the 500 level or above, or 6 semester hours of non-ECE courses approved by the student’s master’s committee and the graduate committee.
- An additional 21 semester hours of 400-level* or above work in electrical engineering or computer engineering, with 15 of the hours at the 500-level or 600-level. Of the 15 hours, at least 6 hours of work in each of two areas of electrical engineering or computer engineering and an additional 3 hours of work outside of the two areas.
- ECE 501 (project in lieu of thesis) with a minimum grade of B. This course will be administered by the student’s master’s committee. A written project proposal describing what the student will do in the course must be submitted in advance for the graduate committee’s approval. A written final report and oral presentation is required and one copy of the final draft must be submitted to the graduate committee.
- A final written and oral examination covering the project and related coursework.

*NOTE: At least two-thirds of the minimum required hours must be taken in courses numbered at or above the 500 level.

DOCTOR OF PHILOSOPHY

Electrical Engineering Major

The PhD is offered with a major in electrical engineering. Exceptional students holding the bachelor’s degree may be admitted to the doctoral program without first obtaining a master’s degree. Candidates holding the MS must satisfy requirements two through seven below while candidates holding only the BS must satisfy requirements one through seven.

Applicants are required to submit scores from the General Graduate Record Exam (GRE). A TOEFL score of 550 on the written exam or 213 on the computer exam is required for non-native speakers of English, including those who have earned degrees at U.S. institutions. Specific departmental requirements for the PhD include the following:

1. For students holding only a BS degree, a minimum of 48 course hours is required. The first 24 course hours should satisfy:
   a. Six semester hours of mathematics at the 400 level or above selected from a list approved by the graduate committee, or 6 semester hours of ECE courses at the 500 level or above, or 6 semester hours of non-ECE courses approved by the student’s master’s committee and the graduate committee.
   b. An additional 18 semester hours of 400-level or above work in electrical and computer engineering, with at least 6 hours of 500-level or 600-level work in each of two areas of electrical and computer engineering.

   In addition the student must satisfy requirements two through seven below.

2. For students holding a MS, a minimum of 24 semester hours of coursework excluding research and dissertation credit or seminar courses must be taken at the University of Tennessee, Knoxville. These hours must include:
   a. A minimum of 12 semester hours in electrical and computer engineering at the 500 and 600 levels.
   b. A minimum of 9 semester hours of 600-level coursework. A least 3 hours of this work must be in an area other than the student’s major area.
   c. A minimum of 6 hours of mathematics at the 500 level or above and approved by the departmental graduate committee.

3. Satisfactory performance on a qualifying examination. The qualifying examination is prepared by the Electrical and Computer Engineering faculty and consists of two 4-hour written examinations covering courses required in the undergraduate electrical and computer engineering curriculum through the junior level. The qualifying examination is offered twice each year (January and August), and a student is to take it the first time it is offered after the student enrolls in the program. A student who fails the qualifying examination must take and pass the examination the next time it is offered to remain in the program. A minimum of 12 hours of coursework must be completed after the student has taken the qualifying examination the first time.

4. Satisfactory performance on a comprehensive examination. The comprehensive examination is administered by the student’s committee; the exam results are reported to the graduate committee for approval; and the exam is filed in the department. The comprehensive exam is given when the student is ready to apply for admission to candidacy. The comprehensive examination consists of both written and oral parts. The written part consists of at least two sections: a complete review of the literature in the student’s dissertation topic, and a review of the major tools to be used in the dissertation work. The student’s committee may require additional written sections. The student must demonstrate a mastery of the dissertation area, ability to think analytically and creatively, skill in using academic resources, and ability to complete the dissertation satisfactorily. The oral part
of the comprehensive examination consists primarily of a professional presentation of a proposal for dissertation work and its defense. The committee may cover additional topics in the oral part.

5. Participation in departmental seminars.
7. Successful public defense of the dissertation by the student.

GRADUATE COURSES

Electrical and Computer Engineering (319)

Note: Courses required in the electrical engineering undergraduate curriculum cannot be used in either the MS or PhD programs. No 400-level course may be used toward a graduate degree in electrical engineering except when required by the program.

400 Senior Design (5) Major design project focusing student's attention on professional practice, accumulated background of curricular components, and recent developments in field. Directed to topics within field of electrical engineering. Level 3 design projects which require laboratory work. Prereq: 316, 325, 332, 342, 355.


421 Electric Energy Systems (3) Structure and operation of electrical energy grid; load flow; economic loading; planning; control; reliability. Balanced and unbalanced faults; system protection; system stability. Level 1 design projects. Prereq: 316, 325.


423 Electric Machines (3) Principles of electromechanical energy conversion. Design procedures for AC and DC machine windings; construction and performance constraints. Effects of machine parameters on steady state and dynamic performances; the d-q model; reference frames. Level 1 design projects. Prereq: 316, 325.


432 Electronic Amplifiers (4) Feedback amplifier principles; wideband linear amplifier design; low-noise preamplifier design; audio power amplifier design; linear regulated power supply design and switching regulator principles. Radio frequency amplifier design; oscillator principles. Laboratory experiments and design projects. Level 2 design projects which require laboratory work. Prereq: 431.

441 Digital Communication (3) Quantization and pulse code modulation. Binary and Mary signaling, spectra of line codes, link budget analysis, binary communication in presence of noise, matched filtering and equalization, bandpass digital transmission, introduction to multiple access techniques. Level 1 design projects. Prereq: 342.

442 Communication System Design (4) Application of communication theory to system design. Development of communication system specifications. System simulation utilizing graphical programming language. Hardware and software design and simulation. Construction and performance evaluation of complete analog or digital transmitter and receiver or significant subsystems. Level 2 design projects. Prereq: 441.

443 Antennas and Propagation (3) Introduction to antenna theory; fundamental antenna concepts and parameters (directivity, gain, patterns, etc.) and signal propagation. Theory and design of linear and loop antennas, arrays, and other simple antennas. Level 1 design projects. Prereq: 316, 341, 342.

446 Electromagnetic Compatibility (3) Principles and practices to avoid interference among and within electrical devices. Parameters and coupling for dipole, biconical, and log-periodic antennas. High frequency effects in circuit elements. Radiated and conducted emissions and susceptibility. Crosstalk, shielding, electrostatic discharge, and EMC regulations. Level 1 design projects that require laboratory work. Prereq: 316, 341, 342.

451 Computer System Architecture (3) Architecture and design of microcomputer systems with microprocessors or microcontrollers. Instruction set architectures, software interfaces, processor structures, memory hierarchy, interfacing. Level 1 design projects that require laboratory work. Prereq: 355.

453 Introduction to Computer Networks (4) Principles of computer networking and software design of network protocol: internet and TCP/IP protocol suite. Level 1 design projects that require laboratory work. Prereq: 206.

471 Introduction to Pattern Recognition (3) Statistical decision theory, adaptive classifiers, and supervised and unsupervised learning. Application of techniques in areas of current interest: face recognition, speech processing, remote sensing, data mining and bioinformatics. Level 1 design projects. Prereq: 316. Non-majors require consent of instructor.


481 Power Electronics (3) Principles and characteristics of power semiconductor devices, single-phase and polyphase phase controlled converters, converter control, ac voltage controller. Level 1 design projects and laboratory work. Prereq: 316, 325, 332.

482 Power Electronics Circuits (4) Voltage-fed inverters, PWM principles, control of inverters, dc-dc converters, ac machine drives, resonance converters, step motor drives, brushless dc machine principles. Level 2 design projects which require laboratory work. Prereq: 481.

491 Special Topics (3) Basic design and current practice. May not be repeated to satisfy senior requirements for graduation. Prereq: Completion of all junior Electrical and Computer Engineering courses or consent of instructor. Level 1 or 2 design projects that may require laboratory work.

495 Senior Seminar (1) Current topics. Prereq: Completion of all junior Electrical and Computer Engineering courses or consent of instructor. Satisfactory/No Credit or letter grade.

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

501 Project in Lieu of Thesis (3) Capstone course taken under supervision of student’s major professor and master’s committee. Individual project involving literature survey, development of some software or hardware, testing, writing a white paper or journal paper, or other suitable project. Prereq: Consent of graduate committee. May be repeated. Maximum 6 hours.

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


504 Random Process Theory for Engineers (3) Probability and random variables as approached by set theory. Statistical averages and transformations of random variables. Random processes, stationarity, correlation functions and temporal analysis, power spectrum and spectral analysis as applied to response of systems to random signals.

505 Digital Signal Processing I (3) Discrete-time signals and systems, sampling, fast Fourier transform (FFT) and fast convolution, design of FIR filters and IIR filters.

506 Digital Signal Processing II (3) Filter properties in the Z and Fourier transform domains, structures for digital filters, sampling and reconstruction, hardware implementation of digital filters.

507 Application of Linear Algebra in Engineering Systems (3) 507 Application of Linear Algebra in Engineering Systems (3) (Same as Biomedical Engineering 507, Chemical Engineering 507, Materials Science and Engineering 507; Mechanical Engineering 507.)

511 Linear Systems Theory (3) State space models of linear dynamical systems, linear algebra, state transition map, matrix exponential, controllability, observability, realization theory, and stability theory. Coreq: 507.

512 Multivariable Linear Control System Design (3) Design of controllers, for multivariable systems, which satisfy constraints on robustness to plant uncertainties, disturbance rejection, command following. Prereq: 511.
618 Special Topics in Systems Theory II (3) Topics of current interest to students and faculty; large scale systems, model order reduction, algebraic and geometric system theories, and advanced design methods. Prereq: 617.

623 Advanced Power Electronics and Drives (3) Phase-controlled cycloconverters, cycloconverter-fed ac drives, resonant converters, vector and scalar control of synchronous machines, static Kramer drives, static Scherbius drives, VSCF generation, modern control theory in ac drives.

624 Electrical Insulation (3) Principles, testing, and case studies. Basic principles of aging, losses, charging, conduction, and breakdown in vacuum, gas, liquid, solid, and composite insulation systems. Testing with low-noise instrumentation, pulse height analysis, optics, acoustics, and bridges; associated statistics and distributed parameter effects. Case studies drawn from active research, power systems, electronic circuits and devices, shielding, and stress grading. Prereq: 503, 504, and consent of instructor.

631 Advanced Topics in Electronic Instrumentation I (3) Based on particular interests of students. Fundamental physical processes in instrumentation transducers; thermoelectric, magnetoelectric, electromechanical and quantum-mechanical devices. Prereq: 531-32 and consent of instructor.


642 Wireless Communications (3) Fundamental theory and design of wireless communications systems; mobile radio propagation; modulation techniques; coding, diversity and equalization. Wireless systems and standards. Prereq: Satisfactory completion of 441 and 504.

643 Detection and Estimation Theory (3) Detection theory; coding theory; system identification. Signals with unknown parameters; optimal filter synthesis; adaptive systems; sequential detection; suboptimal detection. Prereq: 504 or consent of instructor.

644 Coding and Information Theory (3) Structure of algebraic and probabilistic codes; linear codes, convolutional codes, error-correcting codes, decoding methods. Identification schemes: deterministic, stochastic, and hierarchical methods. Prereq: 643.

651 Computer-Aided Design of VLSI Systems I (3) Fabrication of microelectronic devices; computer architecture design; algorithmic state machines; partitioning; structured design methodology. Prereq: 551-552 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.

657 Advanced Computer Architecture and Design (3) Advanced computer architecture issues including topics such as superscalar architectures, parallel algorithms, principles of parallelism detection and vectorizing compilers, interconnection networks, SIMD/MIMD machines, processor synchronization, shared and distributed memory, data coherence, multiprocessors, multicomputers, dataflow machines, special purpose processors. Prereq: 557.

658 Computer and Telecommunications Systems Performance Evaluation (3) Introduction to the basic tools of computer and communications systems analysis and evaluation. Deterministic and stochastic modeling concepts are presented. Queueing theory and discrete event (DES) simulation methods are studied with application to a variety of examples drawn from the computer and communications performance evaluation literature. A standard DES language is used in modeling and simulation studies. Topics of current interest such as computer input/output models, mass memory, bus models, and communications network models are discussed. A modeling project is typically required. Prereq: 504.

659 Digital Systems Verification (3) Three critical issues for robust digital systems are design errors, manufacturing faults, and failures during operation. This course covers digital system verification, testing, and reliability for both timing and logic, in order to prepare students to deal with these in real designs. Verification will cover formal verification for logic and timing, and contrast with simulation. Methods for generating test vectors, scan testing, and built-in self test will be covered. MTBF will be calculated for several small systems with emphasis on models and their limitations. Prereq: 551, 557.

663 Advanced Plasma Physics I (3) Basic concepts of high temperature plasma physics. Magnetohydrodynamics and kinetic descriptions of plasma, plasma transport, plasma waves, equilibrium, and stability. Prereq: Physics 541-542, 461-462 or 563-564, or consent of instructor.

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

671 Image Processing and Robotics I (3) Three-dimensional scene modeling and recognition, multi-sensor 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.

691 Advanced Graduate Seminar (1) Research in department. May be repeated. Satisfactory/No Credit 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 hours.

Department of
INDUSTRIAL AND INFORMATION ENGINEERING

http://www.eng.uctf.edu/ie/

Adeleji B. Badiru, Head
Denise F. Jackson, Graduate Liaison

Professors

Badiru, A.B., PhD, PE .......................................................... Central Florida
Ding, F., PhD ................................................................. North Carolina State
Garrison, G.W. (UTSI), PhD............................................. North Carolina State
Kuo, W., PhD, PE ............................................................. Kansas State

Associate Professors

Aikens III, C.H., PhD ......................................................... Tennessee
Coleman, G.D. (UTSI), PhD, PE .......................................... Virginia Tech
Hailey, M.L. (UTSI), PhD, PE .............................................. Texas Tech
Jackson, D.F., PhD, PE ....................................................... Tennessee
Liggett, H.R., PhD ......................................................... North Carolina State
Sawhney, R.S., PhD ........................................................ Tennessee

Assistant Professors

Ford, R.E., PhD .................................................................. Tennessee
Kim, D., PhD .................................................................. Florida
Kong, D., PhD ................................................................. Penn State

Research Faculty and Staff

Halstead, P.D., BS .......................................................... State University of New York

MAJOR DEGREES

Industrial Engineering ......................................................... MS, MS-MBA, PhD*

The Department of Industrial and Information Engineering offers graduate degrees leading to the Master of Science and a Doctor of Philosophy with a major in industrial engineering.* These degrees offer concentrations in traditional industrial engineering, information engineering, engineering management, human factors engineering, manufacturing systems engineering, and product development and manufacturing (available only in the dual MS/MBA program).

The Departmental Graduate Committee is responsible for administering, promoting, and advancing the general well being of the graduate program. Departmental actions regarding a graduate student may be appealed in writing, first to the departmental graduate committee and then to the departmental faculty.

*Pending final approval from THEC.
ADMISSION

Applicants must first submit a formal Graduate Application for Admission. In addition to the minimum requirements of the Graduate Council, the Department of Industrial and Information Engineering requires the following:

- Three rating forms or letters of reference;
- GRE scores; and
- Essay (2 double-spaced pages—contact department for current topic).

The graduate committee in the department sets any prerequisite courses or other measures that apply to the particular situation of the applicant. The department and the Office of Graduate Admissions must be notified of any change in the entering date after admission has been granted.

MASTER OF SCIENCE

Industrial Engineering Major

Students who enroll in the Master of Science program may select a concentration in industrial engineering, information engineering, engineering management, human factors engineering, manufacturing systems engineering or product development and manufacturing. Each of these concentrations, with the exception of the product development and manufacturing, allows a student to select either a thesis or non-thesis option. Students who select the manufacturing systems engineering concentration of the dual degree program must select the non-thesis option. The thesis option requires 27 hours of coursework and 6 hours thesis. The non-thesis option requires 30 hours of coursework and a 3-hour design project; the engineering management concentration requires an additional 3 hours.

Industrial Engineering Concentration

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

Information Engineering Concentration

Information engineering is concerned with the specification, design, implementation and management of data- and knowledge-intensive information systems. The engineering of large-scale information systems requires knowledge and practical experience in areas such as database management systems, data modeling, information optimization, knowledge acquisition, data/knowledge representation, software systems engineering, and network design and management.

Engineering Management Concentration

The engineering management concentration has an additional admission requirement of two years relevant experience as a practicing engineer or scientist. This concentration is fully supported off-campus utilizing electronic media for videotaping and interactive distance teaching methods.

Human Factors Engineering Concentration

Human factors engineering is concerned with ways of designing jobs, machines, operations, and work environments so they are compatible with human capacities and limitations. The human factors practitioner, operating within an industrial or service environment, is called upon both to apply existing human performance knowledge to the design or modification of work and workplaces and also to generate new experimental data required for system design and evaluation.

Manufacturing Systems Engineering Concentration

Under the manufacturing systems engineering concentration, students learn strategies for improving product quality, implementing various production strategies, analysis of production planning and scheduling systems, and supplier and distribution integration. Dual degree students can select manufacturing systems engineering as an option.

Product Development and Manufacturing Concentration

The product development and manufacturing concentration is a non-thesis option, available only to students taking the dual MS-MBA program.

DUAL MS-MBA

The College of Business Administration and the College of Engineering offer an integrated program leading to the concentration of the Master of Business Administration degree with a major in business administration (concentration in operations management) and the Master of Science degree with a major in industrial engineering (concentration in manufacturing systems engineering or product development and manufacturing).

The Industrial Engineering program is also open to students with undergraduate engineering majors other than industrial engineering.

The establishment of the dual program addresses the critical need for personnel trained in both engineering and management who can integrate an increasingly complex body of knowledge for rapid introduction of new products to the marketplace. The objective of the dual degree program is to prepare graduates to take a leading management role in companies that must react quickly to a dynamic market where forces of competition require rapid changes in design and manufacturing and a short product development cycle.

ADMISSION

Applications are accepted for fall semester only. Applicants for the MS-MBA program must make separate application to, and be competitively and independently accepted by, the Office of Graduate Admissions for the Master of Business Administration degree program and the Master of Science degree program with a major in Industrial Engineering, and by the Dual Program Committee.

Students will initially apply for the MBA program, indicating on their application the intent to pursue the dual MS-MBA program and the industrial engineering major (refer to the MBA program for separate instructions). Students accepted for both the MBA and the MS with a major in industrial engineering
degree programs will be assigned to Dual Program Committee advisors, who will be responsible for course approval and supervision of the students’ progress through the dual program.

Applications by U.S. citizens and permanent residents received after the MBA application deadline (March 1) will be considered as space allows. Additional information is required and different application dates are established by Graduate Admissions for international students.

REQUIREMENTS

All engineering students enrolled in the dual program must complete common coursework designed to provide them with an integrated, multidisciplinary teamwork experience. The MBA curriculum consists of 33 hours of common coursework in the College of Business Administration and 15 hours of common coursework in the College of Engineering. Engineering common coursework includes a culminating 3-hour integrated project course requiring a comprehensive report, and a final examination as required by the Dual Program Committee, to be taken during the first session of summer following the second year.

During the second year dual degree candidates will take courses in their engineering major. The coursework for each option is designed to provide students with a concentration in their major and advanced skills to accomplish their teamwork assignments.

The dual degree candidate must satisfy the curriculum and graduation requirements of the engineering major being pursued and the College of Business Administration. Students withdrawing from the dual degree program before completing both degrees will not receive credit toward graduation in either degree program for courses taken in the other degree program, except as such courses qualify for credit without regard to the dual degree program. The MS and the MBA degrees will be awarded upon successful completion of the requirements of the dual program.

Approved Dual Credit

A maximum of 15 semester hours of the common program courses completed in the College of Engineering may be counted toward the MBA degree program.

DOCTOR OF PHILOSOPHY

Industrial Engineering Major*

ADMISSION

Admission to the PhD program requires an undergraduate degree and academic background that meets the admission criteria for the master’s program in industrial engineering or a master’s degree in industrial engineering (or a closely related field), and previous academic performance that clearly demonstrates the capacity to do original research and technical investigative work and the potential for a successful scholarly career. If admitted, prerequisites (if required) will be established by the graduate committee based on the student’s academic background. All students are required to take the Graduate Record Examinations (GRE), and submit three letters of reference and a personal statement about their professional goals. International students are also required to take the Test of English as a Foreign Language (TOEFL).

*Pending final approval from THEC.

REQUIREMENTS

The total program of study requires a minimum of 72 graduate semester hours beyond the bachelor’s degree, exclusive of credit for the master’s thesis. This includes a minimum of 48 graduate semester hours of coursework beyond the bachelor’s degree and 24 semester hours of doctoral research and dissertation work. For a master’s program completed at another institution or in another field, the requirement may exceed the 48 semester hours of coursework (other than research and dissertation) dependent on the previous program of study.

Graduate Certificate in Maintenance and Reliability Engineering

The College of Engineering offers a graduate certificate in maintenance and reliability engineering. The program is designed primarily for part-time students in that several of the courses are available through distance education.

The 12-credit certificate is earned by completing 483 and 484, which are cross-listed among all participating departments in the College of Engineering, plus two elective courses selected from a list of courses provided by the participating departments. Currently, the available elective courses are Industrial Engineering 516 and 591, Mechanical Engineering 534 and 599, and Nuclear Engineering 579 and 585. The selection of elective courses is determined through an advising conference with each individual student, and is based on the student’s personal interests, academic background, and work experience. Applicants must meet the minimum criteria established by the Graduate Council.

GRADUATE COURSES

Industrial Engineering (556)

Note: Any 400-level course required in the Bachelor of Science in Industrial Engineering program at the University of Tennessee, Knoxville, may not be used for graduate credit in the MS program.

- 403 Production Facilities Design and Material Handling (3) Design of production facilities: plant layout, analysis and planning for overall moving, packaging and storage of materials. Office layout and service areas. Design of facilities for such diverse groups as hospitals, banking, industry. Prereq: 306.
- 421 Information Systems Analysis and Design (3) Systems engineering approach to analysis, design, development, and implementation of systems of information. Informational requirements of industrial engineering systems. Utilization of relevant software packages. 2 hours and 1 lab. Prereq: Senior standing or consent of instructor.
- 422 Senior Industrial Engineering Problems Analysis (3) Application of industrial engineering to field assignments in local organizations, problem definitions, analysis and presentation. Prereq: Expected term of graduation or consent of instructor.

440 Process Improvement Through Planned Experimentation (3) Fundamentals of continuous improvement, advanced statistical process control techniques, and strategies for short production runs. Use of experimental design techniques to improve processes: single and multiple-factor designs, blocking and confounding, and fractional designs. Full factorial designs compared to fractional designs to balance experimental efficiency with loss of information. Lab component utilizes statistical and simulation software to provide hands-on experience. Prereq: 300. Coreq: 421.

455 Human-Computer Interaction (3) Introduction to the analysis, design, production, and implementation of systems requiring interaction between humans and computers (HCI). Includes human sensory systems, human memory capacity, computer hardware/software requirements, input/output device design, and error message handling. Computer Programming skills are required. Prereq: 304. Coreq: 421.

483 Introduction to Reliability Engineering (3) (Same as Chemical Engineering 483; Mechanical Engineering 483; Nuclear Engineering 483.)

484 Introduction to Maintenance Engineering (3) (Same as Chemical Engineering 484; Materials Science and Engineering 484; Mechanical Engineering 484; Nuclear Engineering 484.)

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

501 Design Project (1-3) Enrollment limited to industrial engineering students in non-thesis program. May be repeated. Maximum 6 hours. Satisfactory/No Credit grading only.

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. Satisfactory/No Credit grading only.

503 Industrial Engineering Methods Review (3) Survey of industrial engineering tools and techniques applied to analysis, design, and improvement of manufacturing systems. Required of dual degree students who do not have an undergraduate degree in industrial engineering. May not be counted toward degree requirements. Prereq: Admission to dual MS-MBA program. Satisfactory/No Credit grading only.

504 Product Development Process (1) (Same as Mechanical Engineering 504.)

506 Product Selection and Evaluation (2) (Same as Mechanical Engineering 506.)

508 Integrated Product, Process and Manufacturing System Design (3) Different manufacturing system configurations. Relationships between product design and processing requirements, design specifications and manufacturing costs. Finalizing design specifications and selecting processes. Analysis of manufacturing system costs. Presentation of factors affecting manufacturing system design. Case studies and team projects. Prereq: Consent of instructor. (Same as Mechanical Engineering 508.)

509 Multidisciplinary Project (1) Venue for multidisciplinary student teams to coordinate design and manufacturing tasks of product to be developed. Project management (budget and schedule), assignment of tasks for team members, and concurrent design and manufacturing. Design concepts and product features reviewed by potential customers/investors. Prereq: Consent of instructor. May be repeated. Maximum 3 hours. (Same as Mechanical Engineering 509; Nuclear Engineering 509.)

511 Business Planning and Commercialization (3) Complex issues of product development and business planning required to deliver new product from concept to market. Strategic issues that emerge during product development cycle, beginning with concept to product development to commercialization to eventual product introduction or dismissal. Management practices for successful product development and product management. Prereq: Consent of instructor.

513 Facilities Planning and Design (3) Modern materials handling techniques, computer-aided layout techniques, application of operation research models, and use of these to design manufacturing facility. Prereq: 403 or consent of instructor.

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

515 Advanced Production and Inventory Systems (3) Advanced topics in production planning and inventory systems. Material requirements planning: production planning and master scheduling; just-in-time concepts; distribution requirements planning; and other selected topics. Prereq: 402 or consent of instructor.

516 Statistical Methods in Industrial Engineering (3) Application of classical statistical techniques to industrial engineering problems. Statistics and statistical thinking in managerial context of organizational improvement; descriptive statistics and distribution theory; relationship between statistical process control techniques and classical statistical tools; parameter estimation and hypothesis testing; goodness-of-fit testing; linear regression and correlation; analysis of variance; single and multiple factor experimental designs. Prereq: Probability and Statistics for Scientists and Engineers, or equivalent.


518 Advanced Engineering Economic Analysis (3) Application of engineering economic analysis in complex decision situations. Inflation and price changes; uncertainty evaluation using non-probabilistic techniques; capital financing and project allocation; evaluations involving equipment replacement, investor-owned utilities, and public works projects; probabilistic risk analysis including computer simulation and decision trees; multi-attribute decision analysis; and other advanced topics. Prereq: 405 and Probability and Statistics for Scientists and Engineers I or consent of instructor.

519 Human Factors Engineering and Ergonomics (3) Application of human factor and ergonomic concepts and principles to design and analysis of manned systems and products. Human as biomechanical system; human information processing; minimization of human error; anthropometry; anatomy and physiology; physical and mental workload; effects of environmental factors: temperature, lighting, weightlessness, and vibration on humans; manual materials handling and back injuries; design of workstations and office ergonomics; design of displays and controls; hand tool design; and cumulative trauma injuries. Prereq: Probability and Statistics for Scientists and Engineers I or consent of instructor.

520 Human Factors and Product Safety Engineering (3) Role of human factors and safety engineering, legal implications in product design, product liability, system safety, and system failure analysis. Product testing, reliability, and system safety analysis techniques. Case histories of accident investigations, reconstruction, causality, and product liability litigation. Prereq: 519 or consent of instructor.

521 Advanced Human Factors Engineering Methodology (3) Advanced methodologies used in human factors engineering. Observational methods; function/task analysis; computerized human factors design methods; human reliability and error prediction; evaluation of human-machine interface; modeling techniques; questionnaire and survey design; experimental design, and other selected topics. Prereq: 519 or consent of instructor.

522 Optimization Methods in Industrial Engineering (3) Classical optimization applied to constrained and unconstrained, non-linear, multi-variable functions; search techniques; decision making under uncertainty; game theory; and dynamic programming. Prereq: Operations Research or Engineering Management 537.


525 Systems Modeling and Simulation (3) Modeling of discrete systems using current simulation software and Monte-Carlo simulation. Problem definition, input distributions, output data analysis, model validation and verification, variance reduction techniques, animation of models, and design of simulation experiments. Case studies in variety of domains for simulation modeling. Prereq: Consent of instructor.

526 Advanced Applications of Systems Modeling and Simulation (3) Modeling of discrete, continuous, and combined systems using current simulation software. Development of flexible simulation models to enhance accessibility of simulation models for experimentation. Development of distributed simulation models to represent and test production and supply chain systems. Prereq: 306 or 525. (Same as Management Science 526.)
Characteristics and performance of mass production systems. Lean production concepts and principles. Planning, designing, and implementing lean production systems: line balancing, set-up time reduction, cost management, maintenance support, and other selected topics. Application at enterprise level to achieve competitive objectives. Prereq: 515 or consent of instructor.

552 Advanced Linear Programming and Extensions (3) Linear programming solution procedures, duality, sensitivity, and parametric analysis; and quadratic, separable, integer, and goal programming. Prereq: 301.

555 Advanced Topics in Human-Computer Interactions (3). This course is a combination seminar/hands-on all phases of the product development lifecycle, examining the impact of human-computer interactions (HCI design process) that covers at each. It focuses on a user-centered approach to product design, addressing and applying usability to physical designs and web designs. The course includes lectures, discussions, demonstrations and field trip to a local usability lab. Prereq: 455 or consent of instructor.

591-592-593 Special Topics in Industrial Engineering (1-3,1-3,1-3) Individual or group research projects. Prereq: Consent of instructor. May be repeated.

594 Culminating Integrated Project Report (3) (Same as Mechanical Engineering 594; Nuclear Engineering 594.)

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

601 Operations Research Models in Engineering Economy (3) Mathematical programming techniques applied to capital budgeting; advanced topics in multiple attribute decision analysis; Bayesian analysis of sequential decision making; artificial intelligence in complex decision analyses. Prereq: 518, 523.

602 Nonlinear Optimization (3) (Same as Management Science 651.)


691-692-693 Advanced Topics in Industrial Engineering (3,3,3) Forum to study individually or in groups. Prereq: Graduate standing and consent of instructor. May be repeated with consent of instructor.

Engineering Management (328)

501 Capstone Project (3-6) Application-oriented project to show competence in major academic area. Prereq: Enrollment in engineering management. May be repeated. Maximum 6 hours. Satisfactory/No Credit grading only.

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. Satisfactory/No Credit grading only.

532 Productivity and Quality Engineering (3) Productivity and quality measures defined and used to analyze current competitive position of important sectors of American industry with respect to national and international competition. Study of management theorists and systems which promote or inhibit productivity or quality improvements.

533 Theory and Practice of Engineering Management (3) Principles of engineering management, including: business and organization design, culture, leadership, marketing and competition in global economy, motivation and performance management, empowerment, organizational behavior, and diversity. Systems thinking, learning organizations, and systems dynamics modeling. Principle application to work settings and case studies.


535 Management of Technology (3) Creativity and innovation; incorporation of advanced technology equipment; application of systems thinking; new methods in business and manufacturing organizations; justifying technology; assimilating and managing change; changing management roles; and impacts of new technologies. Prereq: 539 and Industrial Engineering 518.

536 Project Management (3) Development and management of engineering and technology projects. Project proposal preparation; resource and cost estimating; and project planning, organizing, and controlling: network diagrams and other tools. Role of project manager: team building, conflict resolution, and contract negotiations. Discussion of typical problems and alternative solutions. Case studies and student projects. Prereq: 537 or consent of instructor.

537 Analytical Methods for Engineering Managers (3) Survey of management analysis and control systems through IE techniques. Qualitative and quantitative systems: methods analysis, work measurement, incentive systems, wage and salary development, production and inventory control, facility layout, linear programming, and applied operations research techniques. Not for credit for students with undergraduate degrees in industrial engineering.

538 New Venture Formation (3) Factors other than mechanical or chemical which enter into successful establishment of manufacturing or service enterprise. Organizational and financial planning and evaluation. Cost and location studies and market analysis to determine commercial feasibility of new ventures. Prereq: 539.

539 Strategic Management in Technical Organizations (3) Strategic planning process and strategic management in practice; corporate vision and mission; product, market, organizational, and financial strategies; external factors; commercialization of new technologies; and competition and beyond. Prereq: 533 and Industrial Engineering 518 or consent of instructor.


543 Legal and Ethical Aspects of Engineering Management (3) Legal aspects imposed by government and ethical considerations in engineering practice. Selected readings, lecture, discussion, and student presentations. Current topics from government and industry.

Department of MATERIALS SCIENCE AND ENGINEERING

http://www.ENG.CUTLFF.edu/mse/

Raymond A. Buchanan, Interim Head and Graduate Liaison

Professors

Benson, R.S., PhD .................................................. Florida State
Bhat, G.S., PhD .................................................. Georgia Institute of Technology
Breese, R.R., PhD .................................................. Florida State
Buchanan, R.A., PhD, PE ........................................ Vanderbilt
Collier, B.J., PhD .................................................. Tennessee
Dahotre, N.B., PhD .................................................. Michigan State
Egami, T., PhD .................................................. Pennsylvania
George, E.P., PhD .................................................. Pennsylvania
Hansen, M.G., PhD .................................................. Wisconsin
Liaw, P.K., PhD .................................................. Northwestern
Lowndes, D.H., PhD .................................................. Colorado
Lundin, C.D., PhD .................................................. Rensselaer Polytechnic Institute
McHargue, C.J., PhD .................................................. Kentucky
Pedraza, A.J., PhD .................................................. LaPlata (Argentina)
Pharr, G.M., PhD, PE .................................................. Stanford
Simpson, M.L., PhD .................................................. Tennessee
Spruill, J.E., PhD .................................................. Tennessee
Wadsworth, L.C., PhD .................................................. North Carolina State

Associate Professors

Kit, K., PhD .................................................. Delaware
Mech, T.T., PhD .................................................. Ohio State
Graduate programs are offered leading to the degrees of Master of Science and Doctor of Philosophy with a major in materials science and engineering or polymer engineering. Both the materials science and engineering and polymer engineering programs are flexible and interdisciplinary in nature. Students may be admitted from a wide range of disciplines; these include physics, chemistry, chemical engineering, mechanical engineering, electrical engineering, materials engineering, and engineering science programs.

Areas of concentration within the materials science and engineering degree program include metallurgy, polymers, textiles, and materials. Specializations include, but are not limited to: ceramics; composites; electronic materials; physical metallurgy; materials processing; welding metallurgy and materials joining; corrosion science and engineering; biomedical materials; nonwovens science and technology; and mechanical and physical behaviors of materials.

Areas of concentration within the polymer engineering degree program are polymer processing, polymer science, and textile science. Specialty areas include rheology; polymer morphology; mechanical, physical, and chemical behaviors of polymers; composite materials; and nonwovens science and technology.

**ADMISSION**

Applicants for admission to the MS and PhD programs in materials science and engineering and polymer engineering, are expected to have completed a bachelor’s degree in an area of engineering or science with a grade-point-average of at least 3.0 out of 4.0 both overall and in the senior year. In addition, all applicants are required to submit scores from the General Graduate Record Examination (GRE). Applicants whose native language is not English must score at least 213 on the computer-based TOEFL examination or 550 on the written examination to be considered for admission to the programs.

**MASTER OF SCIENCE**

**Materials Science and Engineering Major • Polymer Science Major**

**Thesis Option**

A total of 30 semester hours is required for the MS in either materials science and engineering or polymer engineering. Additional requirements include:

- A major consisting of 12 semester hours of graduate courses in materials science and engineering or polymer engineering. The materials science and engineering major must include 511, 512, 515, and 516 for the metallurgy concentration; 511, 512, 540, and 541 for the polymers concentration; 511, 512, 540, 552, and 553 for the textiles concentration; and 511, 512, and two graduate specialization courses approved by the student’s faculty committee for the materials concentration. The polymer engineering major must include 540, 541, 543, 546, 549, and 550 for the polymer processing and polymer science concentrations; and 540, 541 or 543, 549, 550, 552, and 553 for the textile science concentration; exceptions are given if similar material has been covered in prior coursework.

- Additional courses up to 12 hours total in related areas.
- Master’s thesis 500, totaling 6 to 12 hours.
- Satisfactory performance on a comprehensive oral examination administered by the faculty committee.

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

**Non-Thesis Option**

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

- Completion of a total of 30 hours of graduate coursework. At least 18 of those hours must be in the department, and up to 12 hours may be in related areas. Three hours of Materials Science and Engineering 503 or 504 may be counted toward degree requirements. The materials science and engineering major and the polymer engineering major must include the same courses required for the thesis option. The faculty committee must approve the candidate’s degree program.
- Satisfactory completion of a culminating experience such as Materials Science and Engineering 580 (Critical Review).
- Satisfactory performance on a comprehensive examination administered by the faculty committee.

**DOCTOR OF PHILOSOPHY**

**Materials Science and Engineering Major • Polymer Science Major**

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

**REQUIREMENTS**

Departmental requirements for completion of the doctoral degree are:

- For students proceeding directly to the PhD from the baccalaureate degree: 48 graduate course credit hours with at least six hours of 600-level courses. Six hours
of Materials Science and Engineering 503 or 504 may be counted toward degree requirements. At least 30 credit hours must be courses taught in the department. The materials science and engineering major and the polymer engineering major must include the courses required for the master’s program. In addition, for students in the textile science concentration of the polymer engineering major, the courses must include 541 and 543.

- For students having a master’s degree in materials science and engineering, polymer engineering, or metallurgical engineering: 18 additional graduate course credits with at least six hours of 600-level courses. Three hours of Materials Science and Engineering 503 or 504 may be counted toward degree requirements. At least 12 credit hours must be courses in the department.

- Students must complete at least 24 hours of dissertation credits.

- Satisfactory performance on the applicable comprehensive examination.

- Active participation in graduate seminars conducted by the department. Resident students must register for the appropriate 503 or 504 every semester offered.

GRADUATE COURSES

Materials Science and Engineering (638)

405 Structural Characterization of Materials (4) X-ray diffraction and fluorescence; scanning and transmission electron microscopy; microanalytical techniques.

421 Mechanical Behavior of Materials II (3) Description of stress and strain; linear elastic constitutive equations; isotropic and anisotropic moduli in various materials; yield criteria; brittle fracture, crazing; plastic strain constitutive equations; forming operations and limit criteria. Prereq: 302, Engineering Science 321.

429 Introduction to Ceramic Matrix Composites (3) Characteristics of composites: ceramic matrix composites; macromechanics and materials design; overview of fabrication techniques; microstructural characterization; physical and mechanical property evaluation; current and potential applications. Prereq: 201 and Engineering Science 321 or equivalent.

443 Polymer Processing (3) Rheological measurements; flow through tubes and slits; end effects and extrudate swell; selected applications; screw extrusion, injection molding; synthetic fibers, spinning methods, structure development, properties.

444 Plastics Fabrication and Design (3) Lectures, laboratories and field trips; unit operations of plastics fabrication; plastics classification; design and selection criteria; processing techniques; characterization laboratory.


472 Fundamental Principles of Composite Materials (3) Establishment of physical principles basic to design, manufacture and application of fiber reinforced polymers, metals and ceramics. Prereq: 302 or equivalent.

474 Biomaterials (3) Metals, polymers and ceramics used in orthopaedic, cardiovascular and dental surgical implant devices; corrosion and degradation problems; material properties of primary importance; tissue response to synthetic materials. Prereq: 201. Recommended for engineering science and mechanics majors.

476 Overview of Intermetallic Compounds and Composites (3) Fabrication and processing, ultrafine-grained materials - nanotechnology, thermodynamics and stability, microstructural characterizations, mechanical properties, corrosion and oxidation properties, theoretical modeling, and design and industrial applications of intermetallics and composites. Laboratory demonstrations and group projects. Prereq: 201.

484 Introduction to Maintenance Engineering (3) (Same as Chemical Engineering 484; Industrial Engineering 484; Mechanical Engineering 484; Nuclear Engineering 484.)

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

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. Satisfactory/No Credit grading only.

503 Graduate Seminar in Materials Science and Engineering (1) Prereq: Admission to graduate program. May be repeated. Satisfactory/No Credit grading only.

504 Graduate Seminar in Polymer Engineering (1) Prereq: Admission to graduate program. May be repeated. Satisfactory/No Credit grading only.

505 Engineering Analysis (3) (Same as Chemical Engineering 505.)

507 Application of Linear Algebra in Engineering Systems (3) (Same as Biomedical Engineering 507; Chemical Engineering 507; Electrical and Computer Engineering 507; Mechanical Engineering 507.)

511 Fundamentals of Materials Science and Engineering I (3) Chemical bonding, structures, defects, scattering, thermodynamics, diffusion, phase diagrams, microstructures, and phase transformations.

512 Fundamentals of Materials Science and Engineering II (3) Physical properties: electrical and thermal conduction, elementary quantum physics, band theory, dielectric materials, magnetic and optical properties. Mechanical behavior: stress and strain at a point, elastic constitutive equations, phenomenological bulk behavior, and deformation mechanisms.


522 Defects in Crystals (3) Analytical and experimental analysis of defect interactions in solids. Prereq: 421 or consent of instructor.

523 Plastic Deformation of Metals (3) Geometry and mechanisms of single crystal plastic deformation; slip, twinning, and cleavage, work hardening, effect of temperature, loading rate effects; effect of ordering and solid solution alloying; polycrystalline behavior in terms of single crystal deformation mechanisms; texture formation. Prereq: 301, 320 or consent of instructor.

524 Metallurgical Thermodynamics (3) Applications of chemical thermodynamics to metallurgical problems: refining, oxidation, surface treatments, alloy systems. Prereq: 570 or equivalent.

525-526 Welding Metallurgy (3,3) Welding processes; physical metallurgy of welding; phase transformations; heat flow; residual stresses; theories of hot cracking, cold cracking and porosity formation; applications to process utilization.

528 Ceramic Matrix Composites: Material and Mechanics (3) (Same as Engineering Science 528.)

531 Advanced Corrosion (3) Analyses of corrosion processes in terms of polarization measurements and Pourbaix diagram. Influence of environmental and mechanical factors contributing to pitting, crevice, fretting, wear, fatigue and stress corrosion. Prereq: 470 or consent of instructor.


540 Basic Polymer Chemistry (3) Synthesis, reactions and degradation of polymers. Molecular characterization: solution methods and spectroscopy. Prereq: Semester of organic chemistry and thermodynamics or equivalent.

541 Polymer Rheology (3) Deformation and flow of polymeric materials. Development of empirical models, linear viscoelasticity and finite strain constitutive equations; material functions, temperature dependence and rheometry with applications to synthesis and processing. Elementary kinetic theory of elastic dumbbell suspensions. Prereq: Chemical Engineering 240 or equivalent. (Same as Chemical Engineering 541.)

542 Further Topics in Polymer Processing (3) Description and analysis of selected polymer processing operations. Prereq: 541.

544 Polymer Solution Thermodynamics and Characterization (3) Theories of solutions, statistical thermodynamics. Characterization, treatment of chromatography, viscosity, light scattering and osmotic pressure. Prereq: Undergraduate physical chemistry.

545 Polymer Engineering Processing and Characterization Laboratory (3) Polymer film casting, film blowing, mixing and extrusion are operated and studied. Flow rates, temperatures, pressures and velocity profiles are acquired and used in finite element modeling and simulation to correlate the polymeric material properties and morphology. Supporting instrumentation includes linear viscoelastic rheometry, capillary viscometry, SEM, OM, FTIR, etc. Fundamentals of processing-structure-property relationships are documented in a literature review paper. Prereq: Consent of instructor.

546 Mechanical Properties of Solid Polymers (3) Types of mechanical behavior; Hookean and rubber elasticity; plastic deformation; fracture; linear viscoelasticity; dynamic mechanical behavior and testing; loss tangent; experimental methods. Introduction to mechanical properties of polymeric composites.

549-550 Laboratory Methods in Polymer Engineering (1,2) Basic experimental techniques and instrumentation associated with characterization, x-ray and light scattering, calorimetry, rheometry, mechanical properties of solid polymers, polymer processing operations. Coreq: 540 or consent of instructor. 549-Satisfactory/No Credit grading only.

552 Fiber Science (3) Physical properties, mechanical properties and microstructure of polymeric fibers; relation to end-use properties. Prereq: Organic chemistry and thermal physics or equivalent.

553 Nonwovens Science and Technology I (3) Nonwoven fabric technology; different web forming processes; and relationships among the chemical, morphological and mechanical properties of fibers and orientation in webs to final performance properties of bonded structures. Prereq: Organic chemistry or consent of instructor.

554 Nonwovens Science and Technology II (3) Interrelations between mechanics of production and mechanical properties of nonwoven fabrics; characterization of fiber morphology and web structure; chemistry of nonwovens binders and finishes; and engineering of specific fabric properties. Prereq: 553 or equivalent.

5551 Laboratory Methods in Nonwovens Processing and Characterization (3) Laboratory experience in nonwovens fabrication processes and characterization techniques. Effect of processing conditions on structure development and properties of different types of webs. Prereq: 552 and 553.

560 Principles of Ceramic Processing (3) Treatment of ceramic processing; raw materials preparation and characterization; powder consolidation; drying, firing, sintering techniques, mechanisms and kinetics. Prereq: 360 or equivalent.

570 Optical Microscopy (4) Basic compound and polarizing microscopy for imaging. Optical property measurements, and structure elucidation. Other methods of optical microscopy. 3 hours and 2 labs. Prereq: Physics 232 and 240 or equivalent.

572 X-Ray Diffraction (3) Symmetry of crystals, space group theory, reciprocal lattice and application to definition of structures; powder and single crystal x-ray techniques; introduction to crystal structure determination; characterization of orientation; application to inorganic, metallic and polymer structures.

575 Surface Characterization (3) Analytical techniques for characterizing surfaces of textile materials. Applications of well-established techniques: spectrophotometry and microscopy. Prereq: 552.

576 Special Topics in Materials Science and Engineering (3) Topics of current significance and interest. Prereq: Consent of instructor. May be repeated.


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

621-622 Theoretical Metallurgy (3,3) Topics in solid state physics as applied to metallurgy; introduction to quantum theory, specific heats, electron theory of solids, electrical and thermal conductivity, magnetic properties, theories of alloy formation. Prereq: Consent of instructor.

623 Solidification and Crystal Growth (3) Theories of solidification, fluid flow effects, magnetohydrodynamics of incompressible fluids, growth stability theory, thermodynamic applications, rapid solidification theory, metastability. Prereq: Consent of instructor.

625 Materials Lifetime Science and Engineering I (3) Fundamentals of aqueous and high-temperature corrosion and fatigue; methods of materials lifetime modeling. Prereq: 531 and 532, or consent of instructor.

626 Materials Lifetime Science and Engineering II (3) Interactions between corrosion and fatigue at ambient and high temperatures; lifetime modeling of materials simultaneously subjected to corrosion and fatigue. Prereq: 625.

627 Case Studies in Materials Lifetime Science and Engineering (3) Studies of, and participation in, industrial analyses of lifetimes of structural materials subjected to aqueous-corrosion/fatigue and high-temperature-oxidation/fatigue, performed as part of the student’s industrial and national-laboratory internship programs. Prereq: 531 and 532, or consent of instructor. Satisfactory/No Credit grading only.

628 Graduate Seminar in Materials Lifetime Science and Engineering (1) Seminars by students, faculty, and visiting scholars on materials lifetime science and engineering; processes, mechanisms, and materials lifetime modeling. Prereq: 531 and 532, or consent of instructor. Satisfactory/No Credit grading only.

630 Thin Film Materials Processing (3) Students learn materials issues and thin film processing techniques used to manufacture semiconductor devices. Topics include basic vacuum technology, plasma physics, sputtering, evaporation (resistive, electron beam, laser ablation), chemical vapor deposition, and etching. The mechanisms of each process are explored and relevant material chemistries are discussed. Thin film growth models are also explained and processing variables are related to material properties. Prereq: Permission of instructor.

632 Advanced Topics in Intermetallic Compounds and Composites (3) Thermodynamics, mechanical behavior, corrosion and oxidation, and modeling of intermetallic compounds and composites. Prereq: 476 or permission of instructor.

633 Design of Intermetallic Compounds and Composites (3) Team-based design projects, including literature review, material selection, material/ component design and fabrication, material properties, and theoretical modeling. Prereq: 476 and 632, or permission of instructor.


641 Advanced Rheology and Viscoelastic Theory (3) Continuum mechanics, formulation of viscoelastic theories for describing deformation and flow of polymeric materials. Application to polymer processing problems. Recommended for MS candidates working in rheological areas. Prereq: 541.

642 Advanced Topies in Polymer Processing (3) Application of theories of rheological behavior and of structure development to analysis of polymer processing operations. Prereq: 541. (Same as Chemical Engineering 642.)

643 Phase Transformations in Polymers (3) Glass transition and glassy state; annealing of polymeric glasses; crystallization of polymers; nucleation, growth and morphology; secondary nucleation theory; solidification of copolymers; crystallization under stress. Prereq: 543.

644 Optoelectronic Processes in Polymeric Materials (3) This course introduces fundamental molecular orbital and energy band theories and discusses 1) optical and electronic properties of polymeric materials, 2) principles, design and characterization of polymer optoelectronic devices, and 3) applications of laser spectroscopy in polymer characterizations. The focus is to understand electron related processes and optoelectronic characterizations of polymeric materials and devices. The analysis of laser spectroscopy are also explained in determining structure-property relationships in polymer research. Prereq: 543 or equivalent, and permission of instructor.

672 Introduction to Transmission EM and Electron Diffraction (3) Fundamentals of electron scattering, reciprocal space, the Ewald Sphere construction. Basic electron optics, operation of the transmission electron microscope TEM (includes some laboratory sessions) and sample preparation. The kinematical theory of imaging of perfect and imperfect crystals in the TEM. Problems with the kinematic theory. Introduction to the dynamical theory of TEM imaging. The effect of inelastic scattering in the TEM. Fundamentals of analytical electron microscopy. The Scanning Transmission Electron Microscope (STEM) and its relation to the TEM. Prereq: Either 405, 511, or 572; and permission of instructor.

673 Introduction to Scanned Probe Microscopies (3) A survey of techniques for surface imaging and characterization. Young’s Topograft, field emission, and the beginning of scanning tunneling microscopy (STM). Practical operation of the STM (includes laboratory sessions). Image resolution and interpretation in the STM, analytical STM imaging. The theory and control of feedback loops in SPM. The generalized Scanning Probe Microscope (SPM) and the Atomic Force Microscope (AFM). Theory of operation of AFM, limits to resolution, and image interpretation (includes laboratory session). Important variants of the SPM include scanning capacitance microscopy, scanning thermal microscopy, and scanning thermal microscopes. The metrology of nanoscale structures. Prereq: Permission of instructor.

676 Advanced Topics in Materials Science and Engineering (3) Latest developments and/or advanced special topics. Prereq: Consent of instructor. May be repeated.

678 Seminar in Recent Advances in Materials Science and Engineering (3) Directed and independent study of advanced topics. Prereq: Consent of instructor. May be repeated.
In aerospace engineering, program concentrations include aeroacoustics; aerodynamics and performance; energy conversion and utilization; flight and aerospace mechanics; gas dynamics; heat transfer and fluid mechanics; propulsion; space engineering; structures and stress analysis; and thermodynamics.

In engineering science, program concentrations include applied artificial intelligence, biomedical engineering, computational mechanics, fluid mechanics, mechanics of composite materials, solid mechanics, industrial engineering (PhD only), product development and manufacturing (MS only), optical engineering (UTSI only). In each of these concentrations, interdisciplinary programs are arranged to meet individual needs or interests. The flexibility and interdisciplinary aspect of the program concentrations are intended to be of particular interest to prospective students currently employed in research, development, or design activities and whose interests in continuing education (either full-time or part-time) lie at one of the interfaces between science and engineering or can best be met by interdisciplinary study in engineering. The program’s course offerings and research activities are also intended to meet the needs of students who seek preparation for employment in engineering areas requiring specialization in mechanics or in related interdisciplinary studies such as bio-mechanics.

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

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

Each student must satisfactorily complete a program of study that has been approved by his/her advisory committee and complies with the requirements of the Graduate Council. In engineering science, the student’s major professor may be selected from a department other than the Department of Mechanical, Aerospace, and Biomedical Engineering; however, at least one member of the student’s graduate advisory committee must be on the faculty of the Department of Mechanical, Aerospace, and Biomedical Engineering.

**GRADUATE CREDIT FOR UNDERGRADUATE COURSES**

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

**MASTER OF SCIENCE**

**Aerospace Engineering Major · Engineering Science Major · Mechanical Engineering Major**

**REQUIREMENTS**

In Mechanical Engineering, Aerospace Engineering, and Engineering Science, two MS options are offered. Option I requires a thesis and is the normal program for graduate students. Option II does not require a thesis and provides graduate students, including co-op and other off-campus students, the opportunity to focus their programs in special areas through extended coursework.

Credit requirements for these two options in mechanical engineering and aerospace engineering are:

**Aerospace Engineering Major · Mechanical Engineering Major**

<table>
<thead>
<tr>
<th>Hours Required</th>
<th>Option</th>
<th>I</th>
<th>II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thesis credit</td>
<td></td>
<td>6</td>
<td>n/a</td>
</tr>
<tr>
<td>Coursework</td>
<td></td>
<td>24</td>
<td>30</td>
</tr>
<tr>
<td>Courses in program</td>
<td></td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>(500-level or above) (minimum)</td>
<td></td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>Mathematics (400-level or above)</td>
<td></td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>590 Selected Engineering Problems (maximum)</td>
<td></td>
<td>n/a</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

Credit requirements for these two options in engineering science are:

**Aerospace Engineering Major · Mechanical Engineering Major**

<table>
<thead>
<tr>
<th>Hours Required</th>
<th>Option</th>
<th>I</th>
<th>II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thesis credit</td>
<td></td>
<td>6</td>
<td>n/a</td>
</tr>
<tr>
<td>Coursework</td>
<td></td>
<td>24</td>
<td>30</td>
</tr>
<tr>
<td>Engineering courses (Major concentration may include but is not restricted to courses offered by the department.) (minimum)</td>
<td></td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Mathematics (400 level or above)</td>
<td></td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Related courses (May include additional courses in mathematics, computer science, or the physical and life sciences as well as engineering courses.)</td>
<td></td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>590 Selected Engineering Problems (maximum)</td>
<td></td>
<td>n/a</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

For all program options, other 500 level engineering courses that are approved by the student’s master’s committee and the graduate programs committee may be substituted for the mathematics courses. All program options require participation in the departmental graduate seminars program, and passing a final examination on all work submitted for the degree. The final examinations in Option II will cover all coursework. The thesis option, Option I, requires submission and defense of a written thesis that demonstrates the ability to conduct and report an independent investigation.

**DUAL MS-MBA**

The College of Business Administration and the College of Engineering offer an integrated program leading to the conferral of the Master of Business Administration degree with a major in business administration (concentration in operations management) and the Master of Science degree with a major in engineering science or mechanical engineering (concentration in product development and manufacturing).

The engineering science program is intended to provide other engineering majors an opportunity to participate in this program with a flexible coursework plan based on their undergraduate degree.

The establishment of the dual program addresses the critical need for personnel trained in both engineering and management who can integrate an increasingly complex body of knowledge for rapid introduction of new products to the marketplace. The objective of the dual degree program is to prepare graduates to take a leading management role in companies that must react quickly to a dynamic market where forces of competition require rapid changes in design and manufacturing and a short product development cycle.

**ADMISSION**

Applications are accepted for fall semester only. Applicants for the MS-MBA program must make separate application to, and be competitively and independently accepted by, the Office of Graduate Admissions for the Master of Business Administration degree program and the Master of Science degree program with a major in Engineering Science or Mechanical Engineering, and by the Dual Program Committee.

Students will initially apply for the MBA program, indicating on their application the intent to pursue the dual MS-MBA program and the appropriate engineering major (refer to the MBA program for separate instructions). Students accepted for both the MBA and the MS with a major in engineering science or mechanical engineering programs will be assigned to Dual Program Committee advisors, who will be responsible for course approval and supervision of the students’ progress through the dual program.

Applications by U.S. citizens and permanent residents received after the MBA application deadline (March 1) will be considered as space allows. Additional information is required and different application dates are established by the Office of Graduate Admissions for international students.

**REQUIREMENTS**

All engineering students enrolled in the program must complete a common coursework designed to provide them with an integrated, multidisciplinary teamwork experience. The MBA curriculum in product development and manufacturing consists
of 33 hours of common course work in the College of Business Administration and 15 hours of common coursework in the College of Engineering. Engineering common coursework includes a culminating three-hour integrated project course requiring a comprehensive report, and a final examination as required by the Dual Program Committee, to be taken during the first session of summer following the second year.

During the second year dual degree candidates will take courses in their engineering major. The coursework for each option is designed to provide students with a concentration in their major and advanced skills to accomplish their teamwork assignments.

Curriculum for Dual MS-MBA Degree • Mechanical Engineering Major

August—First Year
Business Administration 511 MBA Core I ..................................................3

Fall—First Year
Business Administration 512 MBA Core II ...........................................15
Mechanical Engineering 504 ........................................................................1

Spring
Business Administration 513 MBA Core III ...........................................9
Mechanical Engineering 506 .................................................................2
Mechanical Engineering 508 .................................................................3

Summer
Internship ..................................................................................7
Business Administration 514 .................................................................3
Mechanical Engineering 509 .................................................................1

Fall—Second Year
Industrial Engineering 511 .................................................................3
Mechanical Engineering 509 .................................................................1
Mechanical Engineering 551 .................................................................1
Mechanical Engineering 537 .................................................................3
Mechanical Engineering 527 .................................................................3

Spring
MBA Hub Course Elective .....................................................................3
Mechanical Engineering 505 .................................................................3
Mechanical Engineering 509 .................................................................1
Mechanical Engineering 510 .................................................................3
Math/Engineering Elective (select with advisor) ........................................3

Summer (first session)
Mechanical Engineering 594 .................................................................3

Total 66

The dual degree candidate must satisfy the curriculum and graduation requirements of the engineering major being pursued and the College of Business Administration. Students withdrawing from the dual degree program before completing both degrees will not receive credit toward graduation in either degree program for courses taken in the other degree program, except as such courses qualify for credit without regard to the dual degree program. The MS and the MBA degrees will be awarded upon successful completion of the requirements of the dual program.

Approval Dual Credit

A maximum of 15 semester hours of the common program courses completed in the College of Engineering may be counted toward the MBA degree program.

DOCTOR OF PHILOSOPHY

Aerospace Engineering Major • Mechanical Engineering Major • Engineering Science Major

REQUIREMENTS

All students must complete 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.

In Mechanical Engineering or Aerospace Engineering, the courses must include:

• A minimum of 12 semester hours of graduate credit in mathematics in courses numbered 400 or above with a minimum of 6 semester hours numbered 500 or above.

• A minimum of 24 semester hours in the department in courses numbered 500 and above, with at least 12 of these semester hours in the major. A minimum of 9 semester hours of courses is required at the 600 level. These are exclusive of thesis, problems, or dissertation credit. The student’s advisory committee can approve a student’s petition to replace one 600-level course with one or more 500-level courses(s) that are more appropriate.

In Engineering Science, the courses must include:

• 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 his/her advisory committee.

- 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.

Additional requirements for all students include:

- Registration and participation in the graduate seminar in the major program.
- Meet all departmental examination requirements, which include passing a written and oral comprehensive examination.
- Presentation of a dissertation proposal to the student’s advisory committee and approval of that proposal by that committee.
- Successful defense of the dissertation.

Graduate Certificate in Computational Fluid Dynamics

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

The 12-hour certificate is earned by completing the three courses, Engineering Science 551, 552, and 581 (CFD Laboratory), which are extensively cross-listed among departments in the College of Engineering. The certificate is completed with one elective 3 hour course from an approved list. Those currently approved are Chemical Engineering 507 and Electrical and Computer Engineering 599 (Computer Fire Modeling). A wider selection of courses will be added when they become available.

The sole academic prerequisite for the certificate program is a bachelor’s degree in engineering. Applicants must meet the minimum admission requirements of the University of Tennessee, Knoxville, Graduate School and become admitted thereto.

Graduate Certificate in Maintenance and Reliability Engineering

The College of Engineering offers a graduate certificate in maintenance and reliability engineering. The program is designed primarily for part-time students in that several of the courses are available through distance education.

The 12-credit certificate is earned by completing 483 and 484, which are cross-listed among all participating departments in the College of Engineering, plus two elective courses selected from a list of courses provided by the participating departments. Currently, the available elective courses are Industrial Engineering 516 and 591, Mechanical Engineering 534 and 599, and Nuclear Engineering 579 and 585. The selection of elective courses is determined through an advising conference with each individual student, and is based on the student’s personal interests, academic background, and work experience. Applicants must meet the minimum criteria established by the Graduate Council.

GRADUATE COURSES
Aerospace Engineering (018)

NOTE: Not all the courses listed below are available at both the University of Tennessee, Knoxville, and UTSI campuses.

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

424 Astronautics (3) Orbital mechanics, propulsion, atmospheric reentry of space vehicles; reentry thermal protection materials, human factors in space flight, space environment and current topics. Prereq: 351. Coreq: Mechanical Engineering 344.

425 Propulsion (3) Principles of propulsion devices; turbo-jet, ram jet and rocket engines. Prereq: 351.


429 Aerospace System Design (4) Synthesis and design of complete aerospace system. Participation in team design effort: formal presentations and design report. Prereq: 422, 425, 426.


494-495 Selected Topics in Aerospace Engineering (1-4) Problems and topics related to developments and practice in aerospace engineering. Prereq: Consent of instructor.

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

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. Satisfactory/No Credit grading only.

511 Inviscid Flow (3) Kinematics and dynamics of inviscid flows; potential flow about body, conformal mapping. Prereq: 422 or 541, Mathematics 425 or equivalent.

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

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

515-516 Air Vehicle Aerodynamics and Performance (3,3) Application of aerodynamics principles to air vehicles to provide estimates of performance, stability, and control characteristics for subsonic to hypersonic speeds. Relations among thrust, drag, lift and attitude, propulsion systems, vehicle performance characteristics, and trajectory optimization. Prereq: 422; 515 for 516.

521-522 Aerodynamics of Compressible Fluids (3,3) One-dimensional internal and external flow; waves; small perturbation theory; slender body theory; similarity rules; method of characteristics. Prereq: 422 for 521; 521 for 522.

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

527-528 Aerospace Ground Test Facilities (3,3) Atmospheric models and similarity considerations; aerodynamic test facilities: continuous and intermittent wind tunnels and ballistic ranges; propulsion test facilities or air breathing and rocket engines; space environment and space vehicle test facilities. Prereq: 521, 541 and Mechanical Engineering 522.

529 Rarefied Gasdynamics (3) Binary elastic collisions; kinetic theory; flow regimes; Boltzmann and model equations, transfer equation, gas-surface interactions; slip boundary conditions, free molecule, slip and transition flow; Monte Carlo simulation; experimental techniques; introduction to hypersonic real gas flows. Prereq: 522, Mechanical Engineering 522.

531 Magnetohydrodynamics (3) Electromagnetic field theory; chemical kinetics; thermodynamic and thermophysical properties of gas plasmas; governing equations and applications. Prereq: 422 and Mathematics 471.
532 Introduction to Turbulence (3) Macroscopic effects, analogies, statistical treatment, correlation functions, energy spectra, diffusion; application of turbulent jets and pipe flow. Prereq: 511-512.

533 Dynamics (3) (Same as Engineering Science 533; Mechanical Engineering 533.)

534 Atmospheric Entry (3) Reentry trajectories; lift and drag during reentry; vehicle motion and stability during reentry; aerodynamic heating and heat protection systems. Prereq: 522. Recommended prereq: 512.

535 Mechanical Vibrations (3) (Same as Biomedical Engineering 534; Engineering Science 534; Mechanical Engineering 534.)

539 Continuum Mechanics (3) (Same as Biomedical Engineering 539; Engineering Science 539; Mechanical Engineering 539.)

541 Fluid Mechanics I (3) (Same as Biomedical Engineering 541; Engineering Science 541; Mechanical Engineering 541.)

542 Fluid Mechanics II (3) (Same as Engineering Science 542; Mechanical Engineering 542.)

544 Transonic Flow (3) Nature of flow at transonic speeds; small disturbance theory; shock wave properties; shock-free flows; strong viscous interaction phenomena; solution techniques. Prereq: 522.


552-553 Advanced Strength of Materials (3,3) (Same as Mechanical Engineering 553-556; Engineering Science 552-553.)

554 Aerospace Vehicle Stability and Control (3) Static and dynamic longitudinal directional and lateral stability and control. Coupled modes. Motion with free and fixed flight control surfaces. Automatic control systems. Prereq: 423, 551.

555 Human Vibrations Analysis and Protection (3) (Same as Biomedical Engineering 555; Mechanical Engineering 555.)

556 Vertical or Short Take Off and Landing Aircraft (3) Performance stability, control of rotation wing, tilt wing, vectored lift and jet vertical riser type aircraft. Vertical and transition flight modes. High lift airfoils. Automatic controls. Simulation facility types and flight testing. Prereq: 555.


559 Advanced Mechanics of Materials I (3) (Same as Biomedical Engineering 559; Engineering Science 559; Mechanical Engineering 559.)

561 Fundamentals of Aeroacoustics (3) Generation, propagation and absorption of sound in static and moving media. Prereq: Consent of instructor.

564 Spacecraft Attitude Dynamics and Control (3) Rotational attitude dynamics of space vehicles. Gyroscopic instruments; passive and active attitude control devices. Linear control theory and attitude stabilization. Prereq: 551, Mathematics 471.

571 Finite Elements for Engineering Applications (3) (Same as Biomedical Engineering 561; Engineering Science 551; Mechanical Engineering 561.)

572 Computational Fluid Dynamics (3) (Same as Biomedical Engineering 562; Engineering Science 552; Mechanical Engineering 562.)

573 Computational Solid Mechanics (3) (Same as Engineering Science 553; Mechanical Engineering 563.)

574 Space Engineering: Satellite Technology (3) Satellites and rockets (orbit, launch vehicles and landing), spacecraft structure, power systems, attitude control system, telemetry/tracking/command, and communication systems; spacecraft testing, reliability, and application of satellites (communication, weather, Earth observation, and future applications). Prereq: 425, Mathematics 471, 404.

590 Selected Engineering Problems (2-6) Enrollment limited to students in problems program. Prereq: Consent of advisor. May be repeated. Maximum 6 hours. Satisfactory/No Credit grading only.

595 Seminar (1) All phases of aerospace engineering, reports on current research at the University of Tennessee, Knoxville, and UTSL. May be repeated. Satisfactory/No Credit grading only.

599 Special Topics in Aerospace Engineering (1-3) May be repeated. Maximum 6 hours.

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

631 Magnetohydrodynamics I (3) Electromagnetic field equations, motions of single charged particle, statistical description of plasma, Boltzmann equation, conduction and diffusion in ionized gases, continuum magnetohydrodynamic equations. Prereq or coreq: 512. Prereq: Mathematics 561 or equivalent.

632 Magnetohydrodynamics II (3) Alfven and shock waves, exact solution for magnetohydrodynamic channel flow, one-dimensional model of channel flow, engineering applications of magneto hydrodynamics, propulsion and power generation. Prereq: 631 and Mathematics 562.

642 Physical Gas Dynamics (3) High speed, high temperature gas flow from molecular point of view. Kinetic theory, statistical mechanics, equilibrium flow, vibrational and chemical rate processes, non-equilibrium vibrational and chemical flow, non-equilibrium kinetic theory, flow with translational non-equilibrium. Prereq: 522, Mechanical Engineering 522.

645 Theory of Turbulence (3) (Same as Engineering Science 645.)

659 Advanced Mechanics of Materials II (3) (Same as Biomedical Engineering 659; Engineering Science 659; Mechanical Engineering 659.)

661-662 Advanced Topics in Computational Fluid Dynamics (3,3) (Same as Engineering Science 651-652; Mechanical Engineering 651-652.)

663-664 Advanced Topics in Computational Solid Mechanics (3,3) (Same as Engineering Science 653-54; Mechanical Engineering 653-654.)


690 Advanced Topics in Aerospace Engineering (3) Prereq: Consent of instructor. May be repeated. Maximum 9 hours.

Biomedical Engineering (192)


430 Biomedical Engineering Laboratory (3) Experience with unique problems associated with making measurements and interpreting data in living systems; experiments: mechanical testing of biological materials, imaging and physiological measurements. Prereq: 310, 346 or consent of instructor.

435 Bioinstrumentation (3) Nature of biomedical signals, transducers, signal processing, noise, telemetry and display devices. Prereq: 300, Computer Engineering 301.


494-495 Special Project in Biomedical Engineering (1-3,1-3) Problems related to recent developments and practice. May be repeated. Maximum 6 hours. Prereq: Junior or senior standing, consent of instructor.

507 Application of Linear Algebra in Engineering Systems (3) (Same as Chemical Engineering 507; Electrical and Computer Engineering 507; Materials Science and Engineering 507; Mechanical Engineering 507.)

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

531 Advanced Biomechanics I (3) Derivation of mathematical models of the human body using Kane's Method of Dynamics to create system equations of motion. Mathematical models will pertain to human non-implanted and implanted joints. Models will be created by hand and using the symbolic manipulation algorithm Autolev. Prereq: Mechanical Engineering 231. (Same as Mechanical Engineering 531.)

534 Mechanical Vibrations (3) (Same as Aerospace Engineering 535; Engineering Science 534; Mechanical Engineering 534.)

539 Continuum Mechanics (3) (Same as Aerospace Engineering 539; Engineering Science 539; Mechanical Engineering 539.)

541 Fluid Mechanics I (3) (Same as Aerospace Engineering 541; Engineering Science 541; Mechanical Engineering 541.)

555 Human Vibrations Analysis and Protection (3) Concepts of whole body vibrations, background information on the development of ANSI and ISO Standards for the protections of workers from whole body vibrations; how to apply the standards to meet the EU requirements; measurement methods and signal processing requirements for whole body vibration; background information on the development of ANSI and ISO Standards for the protections of workers for vibration white finger syndrome; development criteria for current ANSI, ISO, and EU standards; measurements methods and requirements, effectiveness of anti-vibration gloves. Prereq: Mechanical Engineering 363, Mechanical Engineering 534, consent of instructor. (Same as Aerospace Engineering 555; Mechanical Engineering 555.)

559 Advanced Mechanics of Materials I (3) (Same as Aerospace Engineering 559; Engineering Science 559; Mechanical Engineering 559.)

561 Finite Elements for Engineering Applications (3) (Same as Aerospace Engineering 571; Engineering Science 551; Mechanical Engineering 561.)

562 Computational Fluid Dynamics (3) (Same as Aerospace Engineering 572; Engineering Science 552; Mechanical Engineering 562.)

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

572 Biomedical Fluid Mechanics (3) (Same as Engineering Science 572.)

577 Neural Networks in Engineering (3) (Same as Engineering Science 577; Mechanical Engineering 577; Nuclear Engineering 557.)

587 Dynamic Modeling and Simulation (3) (Same as Mechanical Engineering 587.)

599 Special Topics in Biomedical Engineering (1-3) Prereq: Consent of instructor. May be repeated. Maximum 6 hours.

610 Advanced Topics in BME (3) Current research topics of interest in biomedical engineering. Consent of instructor.

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

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

659 Advanced Mechanics of Materials II (3) (Same as Aerospace Engineering 659; Engineering Science 659; Mechanical Engineering 659.)

Engineering Science (335)

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

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. Satisfactory/No Credit grading only.

521-522 Advanced Strength of Materials (3,3) (Same as Aerospace Engineering 552-553; Mechanical Engineering 535-536.)


527 Fracture Mechanics (3) Mechanisms of fracture and crack growth; stress analysis; crack tip plastic zone; energy principles in fracture mechanics; fatigue-crack initiation and propagation; fracture mechanic design and fatigue life predictions; non-linearity, unsteady problems, coupled field equations; isoparametric elements, numerical quadrature. Equation solving, matrix iteration procedures for differential equation statements in engineering and sciences. Approximation, boundary conditions, error extremization/estimation, finite element implementations; comparison to legacy finite difference methods. Applications in 1, 2, and 3 dimensions, non-linearity, unsteady problems, coupled equation systems. Examples from diverse technical fields; fluid mechanics, heat/mass transfer, elasticity, electromagnetics, reacting systems. Computer projects. Prereq: Bachelor’s degree in engineering or natural science. (Same as Aerospace Engineering 571; Biomedical Engineering 561; Mechanical Engineering 561.)

528 Ceramic Matrix Composites: Material and Mechanics (3) Micromechanics and microstructural design; fabrication of ceramic matrix composites; interface characterization and mechanics; electron microscopy examination; nondestructive evaluation; fracture; fatigue; applications. Prereq: Consent of instructor. (Same as Materials Science and Engineering 528.)

529 Fatigue of Engineering Materials (3) Fatigue life prediction, crack initiation, crack propagation. Variable amplitude loading, multi-axial loading, environmental fatigue, creep fatigue, metallurgical and microstructural variables, fractureography, non-metals. Prereq: Consent of instructor.

533 Dynamics (3) (Same as Aerospace Engineering 533; Mechanical Engineering 533.)

534 Mechanical Vibrations (3) (Same as Aerospace Engineering 535; Biomedical Engineering 534; Mechanical Engineering 534.)

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. (Same as Aerospace Engineering 539; Biomedical Engineering 539; Mechanical Engineering 539.)

541 Fluid Mechanics I (3) (Same as Aerospace Engineering 541; Biomedical Engineering 541; Mechanical Engineering 541.)

542 Fluid Mechanics II (3) (Same as Aerospace Engineering 542; Mechanical Engineering 542.)

551 Finite Elements for Engineering Applications (3) Computational procedures for differential equation statements in engineering and sciences. Approximation, boundary conditions, error extremization/estimation, finite element implementations; comparison to legacy finite difference methods. Applications in 1, 2, and 3 dimensions, non-linearity, unsteady problems, coupled equation systems. Examples from diverse technical fields; fluid mechanics, heat/mass transfer, elasticity, electromagnetics, reacting systems. Computer projects. Prereq: Bachelor’s degree in engineering or natural science. (Same as Aerospace Engineering 571; Biomedical Engineering 561; Mechanical Engineering 561.)


553 Computational Solid Mechanics (3) Finite element techniques in structural mechanics and linear elasticity. Two and three-dimensional formulations; iso-parametric elements, numerical integration. Equations solving, matrix iteration techniques. Applications in beams, plates and shells; use of representative computer programs in PC and networked Unix-CAD-solids modeler. Prereq: 321 Mechanics of Materials I or equivalent. (Same as Aerospace Engineering 563; Mechanical Engineering 573.)

559 Advanced Mechanics of Materials I (3) (Same as Aerospace Engineering 559; Biomedical Engineering 559; Mechanical Engineering 559.)


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.

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.

571 Biomechanics of Hard and Soft Tissue (3) Introduction to terminology, physiology, and analytical methods for mechanics of living tissue. Continuum mechanics analysis of hard and soft tissue, biological fluid flows. Flow properties and fluid mechanics. Blood flow; physiology of blood in micro vessels; biophysicodynamics of fluids and solids, mechanical properties of blood vessels; skeletal, heart and smooth muscle; bone and cartilage. Research paper. (Same as Biomedical Engineering 571.)