5830 Seminar in Mathematics Education (3) Current curricular issues. Emphasis on individual student projects and investigation.

5835 Teaching Mathematics in the Senior High School (3) Study of curriculum and teaching problems. Emphasis on methods of teaching "analysis" courses such as Algebra II, trigonometry, analytic geometry and calculus. Prereq: Teaching of Math, Grades 7-12, or equivalent.

5841 Trends and Issues in Early Childhood (3) Historical background, trends, and issues as basis for evaluating current programs; materials and techniques of teaching.

5842 Problems in Education: Early Childhood Education (3) May be repeated. Maximum 9 hrs. Six hrs may be taken concurrently.

5843 Seminar in Early Childhood Education (3) Analysis of research dealing with various aspects of early childhood education (kindergarten-grade 3) with emphasis on application to programs and methods of instruction. Prereq: 5710 or 5850 or equivalent.

5844 Mathematics in Early Childhood Education (3) A study of behavioral characteristics of children in regard to mathematics, content materials and functional instructional settings and teaching strategies for development of mathematical ideas. Prereq: Teaching Arithmetic in the elementary school or equivalent.

5845 Social Studies and Science in Early Childhood Education (3) Systematic examination of integrative approaches to and substantive classification systems of the content areas of Social Studies and Science for the early childhood years. Emphasis on selection of appropriate social studies and science content and approaches for the young child. Prereq: Teaching Social Studies and Science in the elementary school or equivalent.

5846 Language Arts in Early Childhood Education (3) Examination of language development of the young learner with emphasis on teaching methods, procedures, program and materials in an early childhood language arts program. Prereq: Teaching Language Arts in the Elementary School and Teaching Developmental Reading in the Elementary School or equivalent.

5850-60-70 Problems in Education: English (3, 3, 3)

5851-61-71 Problems in Education: Mathematics (3, 3, 3)

5852-62-72 Problems in Education: Social Studies (3, 3, 3)

5853-63-73 Problems in Education: Science (3, 3, 3)

5854-64-74 Problems in Education: Language Arts (3, 3, 3)

5855-65-75 Problems in Education: General Curriculum (3, 3, 3)

5856-66-76 Problems in Education: Instructional Materials (3, 3, 3)

5857-67-77 Problems in Education: Foreign Languages (3, 3, 3)

5858-68-78 Problems in Education: Conservation (3, 3, 3)

5900 Seminar in the Teaching of English in the Secondary School (3)

5901 Linguistics and the Teacher of English (3) Analysis and application of linguistics in the classroom.

5902 Teaching Composition in the High School (3) Techniques for teaching rhetoric.

5903 Teaching Fiction in the Secondary School (3) Reading, study, and analysis of literary selections.

5904 Teaching the Mass Media in the English Classroom (3) To acquaint the English teacher with the nature of mass media and their importance to American education and life.

5905 Teaching English in the Community/Junior College (3) Emphasis upon gaining a thorough understanding of the communication needs of community/junior college students and the objectives, strategies, and materials for meeting these needs.

5906 Teaching Poetry in Grades 7-12 (3) A study of the materials and strategies for teaching poetry.

5907 Teaching Drama in Grades 7-12 (3) A study of strategies and materials for teaching drama in the classroom.

5908 Developing Speaking and Listening Skills in Grades 7-12 (3) A study of strategies and materials for teaching speaking and listening.

5909 Instructional Theory and Design (3) Course is designed for those individuals at the Master's and who have an interest in intensive study of the instructional process and its relationship to curriculum and learning.

5910-20-30 Problems in Lieu of Thesis (3, 3, 3)

5950 The Function of the Thinking Process in Education (3) Analysis of the thinking process for the purpose of tracing its implications for educational theory and practice.

5960 The Teaching of Natural Science (3) Emphasis on teaching strategies, testing and evaluation techniques, and professional guidelines for programs in natural science.

5961 Seminar in Science and Environmental Education (3) Comprehensive studies of recent developments in science education of concern to classroom instruction. Particular emphasis on the interrelationships of environmental factors on science education.

5970 The Teaching of the Social Studies (3)

5980 Projects, Programs, and Materials in Social Studies (3) Examination of projects and aids associated with each of the social science disciplines.

6000 Doctoral Research and Dissertation

6010 Studies in English Education (3) Reading and study in various areas of the teaching of English: composition, language, and literature.

6020 Seminar in Teaching the Social Studies (3) Problems associated with classroom instruction in junior and senior high schools.

6030 Research and Theory in Teaching Reading (3) A systematic study of research and theory in their application to the teaching of reading. Attention will be given to research design as it applies to reading investigations. Prereq: Two 5000-level courses in reading.

6031 Seminar in Reading and Language Arts (3) A critical review of topics new to the broad area of language arts. Two topics each term chosen by the need and the instructor(s). Prereq: 5000-level course in reading and one 5000-level course in language arts.

6040 Seminar in Curriculum and Instruction (1) Required three quarters. S/N only.

6060 Advanced Study of Methodology in the Elementary School (3) Consideration will be given to recent and current literature in the field and to sound educational practices in guiding the learning of children. Prereq: 5640 or consent of instructor.

6070 Advanced Seminar in International Education (3) Analysis of selected problems: political factors in the creation of educational policy, social stratification and its bearing on education in elite and mass societies, relation of education to manpower planning and technological change, and others.

6080 Advanced Seminar in Philosophy of Education (3) A critical study of some selected philosophical issues in education. Prereq: At least 2 courses in History or Philosophy of Education.

6081 Phenomenology and Education (3) A critical study of some selected philosophical issues in education. Prereq: At least 2 courses in History or Philosophy of Education.

6082 Philosophical Analysis and Education (3) The philosophical analysis of the language and concepts used in educational research and writing. Prereq: At least 2 courses in History or Philosophy of Education.

6150 Education as Social Policy (3) Education as an instrument of national or cultural well-being; problems faced by society in shaping an educational program; comparisons of education in this country and in other nations.

6210 Seminar in Elementary School Social Studies Research (3) Survey of current research in elementary social studies, the status of research in the field, needed research-related research from other fields. Prereq: An undergraduate course and one graduate course in social studies, or equivalent.

6230 Programs for Curriculum Improvement (3)

6250 Seminar in History of Education (3) May be repeated with consent of instructor.

6282 Advanced Studies in Elementary School Science (3) A critical analysis of current research in the field of early childhood science. Prereq: An undergraduate course and one graduate course in science, or equivalent.

6350 The Professional Education of Teachers (3) Basic theories, programs, and practices.

6400 The Dynamics of Educational Change (3) Causes of change in education; philosophical issues in education; theories and practice; factors useful in reducing this lag.

6500 Advanced Studies in Early Childhood Education (3) May be repeated. Maximum 6 hrs.

6510 Advanced Studies in Elementary School Language Arts (3) Critical research analysis of some selected issues in elementary school language arts. Prereq: 5280 or equivalent and consent of instructor.

6710 Advanced Educational Statistics (3)

6720 Interpretation of Data (3) Types of data found in published materials in education; principles of sound interpretation.

6730 Theory and Evaluation in Curriculum Planning (3) Application of principles of evaluation to curriculum programs in the elementary and secondary school. Prereq: 5270 or 5410 or equivalent.

6731 Studies in Curriculum Theory and the Structure of Knowledge (3) Analysis of major curriculum theories, models, and designs; structures of knowledge and structures of disciplines in elementary education; evaluation of educational programs. Prereq: 5270 or 5410 or equivalent.

6740 Curriculum Workshops in Instructional Improvement (3) Observation and participation in workshops sponsored by the College of Education. Prereq: Completion of workshop approaches to teacher education and instructional improvement.
52 College of Education

6750-60-70 Problems in Curriculum and Instruction (3, 3, 3)

5830 Studies in Mathematics Education (3)

5600 Problems in Teaching (3)

5860 Theories of Learning (3)

5280 Philosophy and Theory in Educational Administration (3)

5390 The Politics of Education (3) Special em-
phasis on leadership structures, operational beliefs, and communication of ideas with re-
gard to community decisions concerning edu-
cation.

5310 School Administration in a Multi-Ethnic Society (3) Seminar offering opportunity to identify and explore educational problems arising from ethnic and racial diversity, tensions, and hostilities with which school administrators must deal within the individual school or on a district-wide basis.

5420 District Level Administration (3)

5430 Building Level Administration (3) For beginning school principals and administrators, and for those operating in rural elementary, secondary, or consolidated schools.

5440 Introduction to Law, Finance, and Business Management at the Building Level (3)

5450 Organization of the School Program (3)

5470 Introduction to School Facility Planning (3)

5480 Introduction to Supervision and Personnel Administration (3) Principles, methods, and techniques of personnel administration.

5490 Administration of Community Education (3) Examine administrative factors of primary importance in the development of community education programs in the public schools.

5500 Introduction to Educational Planning (3)

5550 Analysis and Interpretation of Research for Educational Administrators (3)

5580 Seminar in Communication Skills for Educational Administrators (3)

5711-21-31 Problems in Educational Administration and Supervision: School Operation (3, 3, 3)

5712-22-32 Problems in Educational Administration and Supervision: Higher Education (3, 3, 3)

5713-23-33 Problems in Educational Administration and Supervision: State School Administration (3, 3, 3)

5714-24-34 Problems in Educational Administration and Supervision: Preparation Programs (3, 3, 3)

5715-25-35 Problems in Educational Administration and Supervision: Community Education (3, 3, 3) Investigations of administrative problems through independent study.

5720 Seminar in Urban School Administration (3) Studying and analyzing administration in urban school districts.

5730 School Business Management (3)

5740 School Law (3) Study of constitutional provisions, special legislation, and legal int-
terpretation of Tennessee law affecting edu-
cational administration.

5751-61-71 Problems in Educational Administration and Supervision: Theory (3, 3, 3)

5752-62-72 Problems in Educational Administration and Supervision: Finance (3, 3, 3)

5753-63-73 Problems in Educational Administration and Supervision: Transportation (3, 3, 3)

5754-64-74 Problems in Educational Administration and Supervision: Business Management (3, 3, 3)

5755-65-75 Problems in Educational Administration and Supervision: Personnel (3, 3, 3)

5756-66-76 Problems in Educational Administration and Supervision: School Plant (3, 3, 3)

5757-67-77 Problems in Educational Administration and Supervision: Organization and Structure (3, 3, 3)

5758-68-78 Problems in Educational Administration and Supervision: School Law (3, 3, 3)

5759-69-79 Problems in Educational Administration and Supervision: Supervision (3, 3, 3)

5770 Maintenance of School Plants (3)

5790 Supervision (3) Supervisory activities of count and city school supervisors. Use of committees, effective techniques for working with groups, relationships with local and state administrative and supervisory personnel, and techniques for the evaluation of supervisory programs.

5790 College Board-Superintendent Relationships (3)

5810 Survey Research Methods (3) Overview of descriptive studies, data collection, analysis, and interpretation for survey studies and school surveys, strategies for descriptive research in education.

5830 Contemporary Economics and Educational Finance (3)

5890 Decision Making and Decision Theory in Educational Organizations (3) This seminar is a laboratory for learning about various theoretical constructs underlying executive decision making and involves direct applica-
tion of decision theory in a variety of problem solving activities. It is designed for both the preservice and practicing administrator. At-
tention is given to executive decision making at the several administrative levels in the com-
plex educational organization. S/NC only.

5910-20-30 Problems in Lieu of Thesis (3, 3, 3)

5930 Administration in Higher Education (3)

599 Specialized Seminar: School Operation (3)

598 Specialized Seminar: Higher Education (3)

5993 Specialized Seminar: State School Admin-
istration (3)

5984 Specialized Seminar: Preparation Pro-
grams (3)

5991 Specialized Seminar: Theory (3)

5992 Specialized Seminar: Finance (3)

5994 Specialized Seminar: Business Manage-
ment (3)

5995 Specialized Seminar: Personnel (3)

5999 Specialized Seminar: School Law (3)

6000 Doctoral Research and Dissertation

6040 Seminar in Educational Administration and Supervision (1) Required three consecu-
tive quarters. S/NC only.

6100 Internship in Educational Administration (3) May be repeated at the discretion of the student's committee. An opportunity for doctor-
tal students and other advanced graduate students to gain experience in the performance of the critical tasks of educational admin-
istration while under the supervision of a prac-
titioner and University representative.

6210 Modern Trends in the Theory and Prac-
tice of Educational Administration and Super-
vision (3)

6220 Programs for the Professional Prepara-
tion of Educational Administrators and Super-
visors (3)

6460 School Personnel Administration (3) Study of personnel administration functions, both professional and supporting staff, in educational organizations. Topics will include recruitment, selection, placement, personnel policies, employee wage and salary admin-
istration, fringe benefits, collective negotiations,
human relations, staff development, and staff evaluation.

6480 Special Topics in School Personnel Administration (3) Topics such as human problems in school personnel administration; staff planning, record systems, personnel policy development; collective bargaining in education; and staff evaluation. May be repeated for a maximum of 12 hours.

6530 Futuristic Educational Planning Methods (3) Study of methods for describing alternative futures.

6550 State-Federal Relations in Education (3)

6550 Legal Foundations of Public Education (3)

6580 Seminar in Managing Conflict (3) Learning about and experiencing various forms of conflict.

6750-60-70 Independent Studies in Educational Administration and Supervision (3, 3, 3) Prereq: Consent of Instructor.

6800 Administration of Complex Educational Organizations (3)

6870 Advanced Study in School Facility Planning (3)

6900 Specialized Doctoral Seminar in Politics of Education (3) Seminar on political theories and practices as they affect the operation of the public school system. Series of appropriate interdisciplinary discussions based on literature and research from education, sociology, and political science. Students will conduct one field inquiry. Prereq: 5920, 5810 or equivalent or consent of instructor.

6996 Specialized Seminar: School Plant (3)

6997 Specialized Seminar in Organization and Structure (3) Survey and critical analysis of organizational theories in education including a systematic review of the status of organizational and leadership research in education and related disciplines; implications for further research; application of existing theory and research to known educational settings. Prereq: Consent of instructor.

6999 Specialized Seminar: Supervision (3)

Educational Psychology and Guidance

MAJORS

Guidance

DEGREES

M.S.: Educational Psychology

M.A.: Educational Psychology and Guidance

Ed.S.: Guidance

Professors:


Associate Professors:


Assistant Professors:


Graduate programs (thesis or nonthesis option) lead to the Master of Science degree with a major in guidance, college student personnel, or educational psychology, to the Specialist in Education degree, and to the Doctor of Education degree. Appropriate courses taken in this department and in the Department of Psychology will satisfy requirements for certification as a school psychologist.

Write the department for information concerning the program requirements. Primary admission dates are February, May, and July.

4110 Psychology of Sex Role Development (3) Examination, from both a theoretical and research base, of factors which contribute to sex role development with attention to changes in sex role definition in society and role of education in these changes. Aimed at the undergraduate or graduate student with minimal background in behavioral sciences.

4130 Mental Health (3)

4350-60-70 Problems in Educational Psychology and Guidance (3, 3, 3)

4440 General Evaluation Procedures for Public Schools (3) Prereq: 3 hrs in Child Study or equivalent.

5454-55-55 Student Leadership Workshops (1, 1, 1) Series of small group and individualized experiences to develop knowledge and skills in leadership roles. Sections are designed for Resident Assistants, Student Government leaders, student activities, and other student organizations. Prereq: Consent of Instructor.

4640 Standardized Testing (3) Use and interpretation of standardized group instruments in the assessment of intelligence, aptitude, achievement, vocational interests and personal characteristics, and needs.

4650 The Construction of Classroom Tests (3) Concerned with teacher-made classroom tests: instructional objectives, principles of test construction, item analysis, evaluating a test's reliability and validity, the interpretation of test scores, the relationship between testing and grading.

4760 Advanced Child Study (3) Prereq: 3 hrs in Child Study. Adolescence or consent of instructor.

4800 Psychology of the Culturally Disadvantaged Child (3) Significant behavioral differences and their causes; appropriate intervention approaches.

4890 Differential Psychology (3) (Same as Psychology 4892.)

4910 Diagnostic and Corrective Teaching (3)

5000 Thesis

5040 Guidance and Pupil Personnel Services in Education (3) (Same as V.T.E. 5040.)

5050 Children and Adolescents (3) Mental, social, physical, and emotional growth, development, and learning of children and adolescents; prevention, identification, and remediation of learning problems.

5060 Group Approaches with Students (3) Knowledge and skills appropriate to functioning with groups in counseling; psychological and parent education.

5070 Seminar in Elementary School Guidance (3) Trends, role, function, and administration of guidance in the elementary school.

5099 Field Work in School Psychology (2) Supervision of supervised training in school psychology for students admitted to a master's level program in school psychology. May be repeated. Maximum 6 hrs. S/NC only.

5100 Developmental Psychology (3) (Same as Psychology 5100.)

5110 Psychology of Women (3) Examination of past and current educational and psychological theory and practice with special attention to assumptions and practice in regard to women; social context in which various theories were developed and current research and theories on women and/or sex differences. Prereq: 4130 or basic course in personality theory.

5111-12-13 Seminar in Current Issues in School Psychology (1, 1, 1)

5140-50-60 Psychoeducational Assessment (3, 3, 3) (Same as Psychology 5140-50-60.)

5149-59-69 Practicum in School Psychology I (2, 2, 2) (Same as Psychology 5149-59-69.) S/NC only.

5180-90-200 Educational Specialist Research and Thesis (3, 3, 3)

5210 Interpretation and Evaluation of Research Reports in Educational Psychology (3) Emphasis on developing research and experimental research in educational psychology, guidance and counseling, and college student personnel. Prereq: Non-thesis option students only or consent of instructor.

5220 Interpretation and Evaluation of Research Reports in Educational Psychology (3) For students not conducting their own research projects; interpret and evaluate statistical tables and statistical tests as reported in journals. Prereq: 5210 or consent of instructor.

5319 Field Work in School Psychology: Level I (2)

5320 Advanced Classroom Behavior Modification (3) Current theories and research in psychology and its application to educational problems.

5330 Theory and Research in Human Learning (3) Influence upon school practice. Prereq: 5320. (Same as Cont. and Higher Educ. 5330.)

5331 Current Developments in Human Learning (3)

5340 Group Dynamics (3) Principles of group dynamics as they apply to a variety of educational practices in administrative, supervisory, and instructional aspects of the school program (Same as Psychology 5340.)

5350 Educational Applications of Cognitive Theories (3) Developmental theory of Jean Piaget and implications for educational practice. Related theorists such as Bruner and Ausubel.

5355 Student Personnel in Higher Education (3) Philosophy and scope.

5356 The College Student (3) Nature, characteristics, and needs.

5370 Case Studies in College Student Personnel (3) Prereq: 5550 or consent of instructor.

5371 Evaluation in Education (3) Techniques and instruments for identifying and appraising social values, the thinking processes, social adjustment, emotional needs, personal interests and problems.

5375 Verbal Behavior and Classroom Learning (3) Overview of theories of verbal development, the role of verbal deficiencies in learning difficulties, diagnosis and counselling of the verbally deficient child. Prereq: Psychological and/or Educational Management.

5378 Career Development: Theory and Research (3)

5384 Student Appraisal (3) Gathering, interpreting, and using data for development of guidance programs and individual counseling. Prereq: Ed. Psych. or Psych. 4640 or equiv-
6810 Seminar in Counseling (3) Prereq: 5890 or consent of instructor.

6941-42-43 Practicum in Guidance, Counseling, and Personnel Services (3, 3, 3) Supervised practice, application of guidance tools and techniques. Minimum: 90 clock hours each quarter. Prereq: 5890 and consent of instructor.

6944-45-46 Teaching Practicum in Educational Psychology and Guidance (3, 3, 3) Prereq: Acceptance in doctoral program and consent of instructor.

6950 Counseling Supervision (3) May be repeated with consent of advisor. Prereq: 5890, 5940, 5910, 6941. S/NC only.

Special Education and Rehabilitation

MAJORS

Vocational Rehabilitation Counseling M.S.

DEGREES

M.S.

4000 Rehabilitation Practicum (3) Evaluation of disability insurance claims; principles of evidence. Prereq: Admission to program in Disability Evaluation or consent of instructor.

5710-20 Medical Aspects of Disability Evaluation (4, 4) Study of the nature and effect of impairments for which individuals may be evaluated for disability insurance purposes; emphasis on the study of written medical reports and the use of disability evaluation criteria; practical experience in designing, conducting, and reporting work evaluation procedures in a workshop setting. Prereq: 5730 or consent of instructor.

5730 Vocational Assessment in Disability Evaluation (3) Theory and techniques of vocational assessment; use of resource materials; study of the criteria for vocational assessment of disability insurance claims under Social Security; on-site job analysis and case file vocational assessment experiences. Prereq: Admission to program in Disability Evaluation or consent of instructor.

5740 Problems/Practicum in Work Evaluation (3) Theory and techniques of work evaluation; application of principles of disability insurance claims evaluation criteria; practical experience in designing, conducting, and reporting work evaluation procedures. Prereq: 5730 or consent of instructor.

5750 Principles and Problems of Disability Evaluation (3) Seminar; individual identification and analysis of principles and problems of disability evaluation process or structures; emphasis on problems of disability evaluation process or structures; emphasis on the criteria by which they should be evaluated for disability insurance purposes; emphasis on the study of written medical reports and the use of disability evaluation criteria; practical experience in designing, conducting, and reporting work evaluation procedures in a workshop setting. Prereq: 5730 or consent of instructor.

5760 Seminar: Functional Capacity Assessment (3) Study of the criteria for residual functional capacity assessment in disability insurance claims evaluation; problems in achievement or acquisition of residual functional capacity assessments. Prereq: 5710-20 or consent of instructor.

5770-71 Current Problems in Disability Claims Evaluation (1-3, 1-3) Group examination of current problems in process, content or administration of disability claims evaluation; workshops in identification and proposal of alternative solutions. May be repeated with consent of instructor. S/NC only.

EDUCATION OF THE ACOSTICALLY HANDICAPPED

4000 Rehabilitation Practicum (3) Evaluation hearing impaired and deaf people is provided.

For further information write the department head.

MULTIPLE DISABILITIES

4130 Education of the Brain-Injured Child (3) Nature and effect of brain injuries; skills for identifying educational, physical, and emotional characteristics; special educational techniques.

4150 Education of the Hospitalized and Homebound Children (3) School and home responsibilities for physical care and social relationships, educational adjustment, vocational needs, and cooperation with related service resources.

4840 Education of the Cerebral Palsied Child at Home and School (3) Physical, social and educational needs of cerebral palsied; evaluative techniques; related services.

4921 Student Teaching in Crippling and Special Health Conditions (3-15) S/NC only.

DISABILITY EVALUATION

5700 Disability Evaluation: Issues, Processes and Programs (4) Evolution of the philosophy and programs of disability insurance under Social Security; study of disability claims action process; emphasis on the criteria and principles of evidence. Prereq: Admission to program in Disability Evaluation or consent of instructor.
of client data practicing rehabilitation prognosis. Prereq: 4230.

4190 Speech Development of the Hearing Impaired (3) Anatomy and physiology of the speech system. Relationship of hearing to speech development. Theories and techniques of speech development and improvement for hearing impaired children. Prereq: Audiology 3050. (Same as Audiology and Speech Pathology 4190.)

4200 Practicum in Speech Development of the Hearing Impaired (3) Applications of theories and techniques of speech development and improvement with hearing impaired children. Prereq: and consent of instructor. (Same as Audiology and Speech Pathology 4200.)

4210 Language Development of the Hearing Impaired I (3) Systems by which formal language is presented. (Same as Audiology and Speech Pathology 4210.)

4220 Language Development of the Hearing Impaired II (3) Techniques; various systems by which formal language is presented. Pre- req: or Coreq: of instructor. (Same as Audiology and Speech Pathology 4220.)

4230 Communication Processes for the Hearing Impaired (3) The various communicative skills required by the hearing impaired person. Reading and teaching language; auditory training; speech-reading; manual language and its relation to other forms of communication. Students must acquire a degree of proficiency in the use of manual language.

4240 Nature of Hearing Impairments (3) Basic principles of audiology; anatomy and physiology of hearing; hearing loss; methods and instrumentation for the assessment of hearing level; interpretation of audiograms; speech and use of hearing aids; relation of audiologic services to medical and other rehabilitative disciplines. Observations and practicum.

4250 Introduction to the Education and Psychology of the Deaf (3) (Same as Audiology and Speech Pathology 4250.)

4280 Curriculum Development in Elementary and Secondary Schools for the Deaf (3) Adaptation of curriculum development and methods in public school education to meet needs of deaf and hard of hearing students in residential and integrated settings.

4290 The Teaching of Reading to Hearing Impaired Children (3) Reading readiness activities, phonics, dictation, comprehension, and adapted reading materials. Prereq: or Coreq: 4210 or consent of instructor.

4410 Instructional Media for the Deaf: Materials Preparation and Utilization (9) For in- stitute participants only. Introduction to basic skills and techniques for preparing and using visual displays, graphic materials, and projected media in classrooms for the deaf. Practical applications of media to the problems of educationally handicapped children. Prereq: Consent of instructor.

4470 Student Teaching of Acoustically Handicapped Children (9) S/NC only.

4471 Practicum with Acoustically Handicapped Children (6) S/NC only.

4539 Laboratory in Auditory Rehabilitation (1) (Same as Audiology and Speech Pathology 4539.)

5040 Advanced Clinical Practice in Audiology (1-6) (Same as Audiology 5040.)

5220 Linguistics in the Education of the Audiologically Impaired (3) Recent research and developments in linguistics related to auditory impairment.

5240 Seminar in Language Remediation for the Hearing Impaired (3) Projects and discussion will pertain to current and recent developments in educational methodologies and techniques of teaching language to the hearing impaired. The topics will include research and materials current in the use of language for hearing impaired children. Emphasis will be placed upon approaches which accommodate and assist the integration of hearing impaired children in the regular classroom.

5260 Seminar on Educational Implications of Language Development. Discussions, readings, and projects will pertain to the impact of language deficiency on educational programming for the variety of children whose educational handicap may be defined in terms of language deficiency.

5310-20-30 Manual Communication (2, 2, 2) Acquisition of basic and advanced skills in fingerspelled and signed forms of communication. Emphasis is on ability to express and receive the manual forms. Prereq: Consent of instructor. Must be taken in sequence.

5410 Instructional Media for the Handicapped: Design, Production, and Evaluation of Proto- typical Curricular Materials (9) Perception, communication, and learning theories; media design and advanced production techniques; evaluation of printed and producing prototypical media materials specifically designed to meet the needs of handicapped learners. Emphasis on planning and producing specific programs that meet the special needs of persons holding major responsibilities for media in a program for the handicapped or similar setting. Prereq: 4410 or equivalent. (For Summer Media Institute only.)

5490 Educational and Social Guidance for the Deaf and Hard of Hearing (3) Evaluation: test techniques for diagnosis and guidance; social and personality adjustment; occupational opportunities.

5540 Seminar in Language Pathology (3) (Same as Audiology and Speech Pathology 5540.)

5820 Curriculum Development Applied to Pro- grams for the Hearing Impaired (3) Analysis of current curriculum trends in order to adapt them for the hearing impaired individual. Application of new curriculum options in the education of these children. Implementation of current audit of educational programs for hearing impaired children. Prereq: C & 15580 or the equivalent and consent of instructor.

EDUCATION OF THE EMOTIONALLY DISTURBED

4610 Nature and Characteristics of Learning and Behavior Disorders (3) Forms of academic and socially disturbing behavior, degrees of severity, possible causes, and relationships to other. Relationships with respect to per- sonality characteristics and developmental factors interpreted through behavioral and psy- chodynamic theory as well as practical situa- tions in which learning and behavior disorders may occur.


4630 Practicum in Residential Settings Serv- ing Children with Disturbing Behavior (3) Practice in scientifically identifying, observing, and recording disturbing behaviors, initiating be- havior changes regarding academic and social behaviors. Performance in a tutorial capacity within residential classroom, and with supervision in discussion and evaluation of relevant academic curriculum and reinforcement sched- ules. Prereq: 4610 and 4620 or consent of instructor.

4640 Practicum in Public School Systems Serving Children with Learning and Behavior Problems (6) Academic tutoring in a teacher/ aide capacity within regular classrooms. Par- ticular emphasis and practice in individualizing instruction for learning and behavior problem children within the regular classroom setting. Discussion and presentation of relevant methods and materials unique to each teaching situa- tion. Prereq: 4610 and 4620 or consent of instructor.

4924 Student Teaching of the Emotionally Disturbed (9) S/NC only. Observation and teaching. Prereq or Coreq: Student Teaching Grades 1-12. S/NC only.

EDUCATION OF THE MENTALLY RETARDED

4110 The Nature and Concept of Mental Retardation (3) Identification, description, and study.

4120 Education of the Mentally Retarded Child (3) Philosophy and rationale underlying the teaching and educational approach for emotionally re- tarded; methods and materials in special and regular classes. Prereq or Coreq: 4110.

4440 High School Programs for the Mentally Retarded (3) Trends, issues and research relating to core and work study programs.

4810 Student Teaching Mental Retardation (3) Prereq: for eligible ed. mentally retarded. S/NC only.

4811 Student Teaching Mental Retardation (9) S/NC only.

4922 Student Teaching of the Educable Mentally Retarded (3) Observation and supervised practicum. S/NC only.

5111 Psychology of Mental Retardation (3) Intellectual functioning, psychological theories and learning interrelations and their theoretical and educational implications emphasized. Prereq: 4110.

5112 Psychology of the Severely Mentally Retarded (3) Program and curriculum development for training/education of the severely retarded in the public schools, institutions and privately operated schools and workshops.

5113 Advanced Curriculum for the Mentally Retarded (3) Investigation and analysis of edu- cational models, methodologies and curricula in the education of mentally retarded children and adults. Emphasis on the varied curricula alternatives to the retarded child's education.

EDUCATION OF THE VISUALLY HANDICAPPED

4150 Education of Partially Sighted Children (3) Curricular adjustments and materials; home visits for parents' cooperation in medical care and special needs.

4850 Eye Problems Encountered by the Teacher (3) Eye anatomy and hygiene; common diseases and defects; testing and treat- ment; educational adjustments for specific eye conditions; related service resources.

4923 Student Teaching of the Partially Seeing (3) S/NC only.

SCHOOL SPEECH AND HEARING THERAPY

4030 The Public School Speech and Hearing Program (3) Organization, administration, and procedures.

4040 Appraisal of Speech and Language Dis- orders (3) (Same as Audiology and Speech Pathology 4040.)

4049 Lab in Appraisal of Speech and Language Disorders (1) (Same as Audiology and Speech Pathology 4049.)
nomics, Distributive, and Industrial Education and in general Vocational-Technical Education.

DOCTORAL PROGRAM

The comprehensive Ed.D. program in Vocational-Technical Education is designed to provide for achieving professional objectives, developing needed competencies, and gaining desirable experiences and understanding of vocational-technical areas.

The Vocational-Technical Education doctoral curriculum consists of the following: professional education core, 15 quarter hours; area of concentration—basic, 3 hours; service area, 18 hours;梵, problems, and innovations in vocational and technical education, 18-27 hours; cognate fields, 9-18 hours; research techniques, 6-12 hours; and dissertation, 36 hours. A minimum of 120 hours above the baccalaureate is required.

4750 Audiovisual Methods and Techniques (3)
(Same as Curriculum and Instruction 4750.)

5010 History and Organization of Vocational-Technical Education (3) Development of vocational and technical education in the public schools through an analysis of social forces, legislation and organizational models.

5040 Guidance and Pupil Personnel Services in Education (3) (Same as Educational Psychology 5040.)

5100-90-5200 Educational Specialist Research and Thesis (3, 3, 3) Selection, analysis and completion of a problem necessitating original investigation which will be beneficial to the investigator and the vocational-technical field.


5260 Continuing Education in Vocational-Technical Education (3) Importance, objectives, historical development, psychological and sociological formulations, methods and techniques.

5270 Placement, Follow-up and Evaluation Procedures in Occupational Education (3) A comprehensive course to explore the methods and procedures in establishing placement programs, follow-up procedures, evaluation, and curriculum revision in occupational education.

5300 Occupational Program Development for Disadvantaged Persons (3) Emphasis will be on problems of the academic, socioeconomic, cultural and/or other handicaps that prevent individuals from succeeding in regular vocational education programs.

5310 Supervision of Vocational-Technical Education (3) Principles of supervision of program planning, coordination and instruction. Roles and functions of supervisors.

5580-50-70 Problems in Vocational-Technical Education (1-6, 1-6, 1-6) May be repeated. Maximum 9 hrs.

6000 Doctoral Research and Dissertation

6040 Seminar in Vocational-Technical Education (1, 1, 1) Required 3 consecutive quarters during residency. S/NC only.

6210 Curriculum Planning in Vocational-Technical Education (3) Prereq: Curr. and Inst. 5410 or equivalent.

6220 Program Planning and Development in Vocational-Technical Education (3) Concepts and principles of planning vocational-technical and manpower state, local and institutional programs; use of research in planning, role of advisory committees, theories of planned change, administrative structures, and evaluation procedures.

6230 Evaluation of Vocational-Technical Education Programs (3)

6310 Administration of Vocational-Technical Education (3) A study of administrative principles and their relationship to vocational and technical training.

6411-12-13 Internship in Vocational and Technical Education (3, 3, 3) Field experiences in selected areas of vocational and technical education. S/NC only.

Agricultural Education

4510-20-30 Problems In Agri-business Education (1-6, 1-6, 1-6) May be repeated. Maximum 9 hrs.

4710-20-30 Seminar In Agricultural Education (1, 1, 1) Prereq: Student teaching in Agric. Ed. or consent of department head.

5000 Thesis

5011-21-31 Problems In Lieu of Thesis (3, 3, 3)

5110-20-30 Current Literature (1, 1, 1)

5230-30-30 Agricultural Education In Off-Farm Agricultural Occupations (3, 3, 3) Principles and procedures for developing occupational experience programs; course planning and teaching procedures. Prereq: Student Teaching in Agric. Ed. 9 hrs.

5340 Agricultural Education for First-Year Teachers (3) Assistance in adjustment to situation in which employed; group meetings in selected centers and visits by instructor. Prereq: Student teaching in Agric. Ed. 9 hrs.

5470 Adult Education in Agriculture (3)

5480 Supervision of Student Teaching in Agricultural Education (3)

5480 Supervised Occupational Experience in Agriculture (3) Prereq: Student Teaching in Agric. Ed. 9 hrs.

5620 Teaching Agricultural Mechanization in Vocational Agriculture (3) Prereq: Student Teaching in Agric. Ed. 9 hrs.

5750-60-70 Special Problems in Agricultural Education (3, 3, 3)

Business Education

4230 Curriculum Construction in Business Education (3) Aims, principles, practices and problems involved in the construction of business curricula for the various types of educational institutions in which business subjects are taught.

4610-20-30 Problems in Business Education (3, 3, 3)

5000 Thesis

5011 Problems in Lieu of Thesis (3)

5110 Graduate Seminar In Current Problems (3)

5111-12-13 Graduate Seminar: Current Problems in Business Education (1, 1, 1)

5120 Graduate Seminar in Tests and Measurement (3)

5130 Graduate Seminar in Guidance (3)

5140 Organization and Operation of Area Vocational-Technical Schools (3) (Same as Industrial Education 5140.)

5410-20-30 Practicum in Business Education (2, 2, 2)

5510 Evaluation of Research In Business Education (3) Prereq: Curriculum and Instruction 5610 or equivalent.

5611-21-31 Problems in Business Education: Typing (3, 3, 3)

5612-22-32 Problems in Business Education: Shorthand (3, 3, 3)

5613-23-33 Problems in Business Education: Bookkeeping and Accounting (3, 3, 3)

5614-24 Problems in Business Education: Technical Practice (3, 3, 3)

5615-25-35 Problems in Business Education: General Business (3, 3, 3)

5617-27 Problems in Business Education: Business Law (3, 3)

5618-28-38 Problems in Business Education: Administration (3, 3, 3)

5619-29 Problems in Business Education: Psychology and Skill Building (3, 3)

6110-20-30 Current Issues in Business Education (3, 3, 3)

6210-20-30 Advanced Studies In Business Education (3, 3, 3)

6410 Higher Education for Business (3)

Distributive Education

4130 Areas of Distribution (3) Marketing, product or service technology, social skills, basic skills, and distribution in the economy as these areas affect the distributive education curriculum in secondary and post-secondary programs.

4140 Supervised Distributive Experience (3) Minimum 200 hours experience in approved distributive business; concurrent analytic project.

4310 Organization and Operation of Distributive Education (3) Background and development; needs; Federal and State Legislation; curriculum implications; establishing, evaluating, reporting, and improving the programs.

4320 Methods and Materials in Distributive Education (3) Prereq: 4310 or consent of instructor.

4410 Coordination Techniques in Distributive Education (3) Selecting training agencies; job analysis; selecting and briefing the training supervisors; advisory committees; adult and other community services. Prereq: 4310, 4520.

4510-20-30 Problems in Distributive Education (3, 3, 3) Selected research problems in teaching and coordinating distributive education programs.

5000 Thesis

5110 Administration and Supervision of Distributive Education (3) Operation of a distributive education program and the work of the city or county supervisor. Understanding and appreciation of problems from the high school principal's and the department head's point of view. Trends in distributive education, including community surveys, state plans, teacher-coordinator qualifications, the changing curriculum.

5120-25-35 Supervising and Teaching Adult Distributive Education (3) Planning, organizing, promoting, teaching, and evaluating continuing education programs in distributive education, utilizing the services of the associations, employment agencies, business groups, and advisory committees in implementation.

5210-20-30 Special Problems in Distributive Education (3, 3, 3) Individual research, conferences, and/or workshops in teaching and supervising high school, post-secondary, and adult programs.
5616-26-36 Problems in Distributive Education: Retailing (3, 3, 3)

Home Economics Education

5000 Thesis

5110 Advanced Methods of Teaching Homemaking Classes for Adults (3)

5130 Furthering Good Human Relationships in the Classroom (3) Relationships between problems in human relations, basic needs of individuals, techniques of interpersonal relations and social values in developing more effective teacher education programs.

5220 Evaluating in Home Economics Education (3) Purpose of evaluation in development of home economics programs: analysis of techniques used in evaluation. Development of techniques for determining progress of students; emphasis on individual problems of evaluation.

5310 The Problem Method of Teaching Home Economics (3) Underlying philosophy; skills and techniques. Observation and discussion.

5520 Teaching Home Economics in College (3) Methods, organization, and evaluation.

5530 Organization of the Homemaking Curriculum in Secondary Schools (3) Critical review of recent advances in home economics education. Consideration will be given to the development of teaching material in relation to total homemaking program in the secondary school—day-school, adults, home experience, and Future Homemakers of America.

5610 Supervision of Home Economics in the Public Schools (3) For teachers with successful experience in vocational home economics who are preparing for supervisory positions in vocational education. Program planning, organization, and administration. Field contacts with urban and rural programs.

5810-20-30 Problems in Home Economics Education (3, 3, 3)

5910-20 Seminar in Home Economics Education (3, 3) Research literature and techniques. Prereq: Consent of instructor.

Industrial Education

3110 History and Philosophy of Industrial Education (3)

3210-20-30 Part-Time Programs in Cooperative Industrial Training (3, 3, 3) Principles of organization, methods and materials.

3310 Shop Organization and Management (3)

3320-30 Materials and Methods for Shop and Related-Subjects Teachers (3, 3)

3340 School Shop Safety (3)

3610 Development and Utilization of Advisory Committees (3) Philosophy and rationale for use of craft advisory committees. Their selection, organization, implementation and utilization.

4110 Foremanship Training by the Conference Method (3)

4120-30 Job Analysis (3, 3) Principles, practice, instructional methods.

4310-20 Curriculum Building in Trade and Industrial Subjects (3, 3) Prereq or coreq: 4120.

4510-11-12 Seminar in Industrial Education (3, 3, 3) Educational innovations, current events, problems, and other topics associated with the field of industrial education.

4520-21-22 New Developments in Industrial Education (3, 3, 3) Developments, pressing problems, and recent trends in the field of industrial education as presented by a coordinating instructor in conjunction with knowledgeable resource personnel.

4621 Special Topics in Drafting (3) Industrial practices in specialized areas of drafting selected for the individual student. Prereq: 6 hrs drafting.


4671 Materials and Processes (3) Organic and inorganic materials and processes used to produce finished products. Content, curriculum and techniques of laboratory operation. Prereq: Consent of instructor.

4682 Power and Energy (3) Development, control, transmission, conversion, interrelations of power sources, content, curriculum, and techniques of laboratory operation. Prereq: Consent of instructor.

5000 Thesis

5110-20-30 Administration and Supervision of Industrial Education (3, 3, 3) Principles of vocational education: relationships with general education and with trade and labor organizations; special problems in administering and supervising various types of schools and classes under the federal vocational education acts.

5140 Organization and Operation of Area Vocational-Technical Schools (3) Understanding of the area vocational-technical school concept: administration and supervision of vocational and technical education programs in area schools. (Same as Bus. Ed. 5140.)

5210-20-30 Special Problems in Industrial Education (3, 3, 3)

5310-20 Methods of Research in Industrial Education (3, 3)

5410 Improving Teachers in Service (3) Problems of coordination, part-time and apprentice training programs.

5420 Advisory Committees and Apprentice Training (3)

5430 Vocational School Administration and Management (3)

5440 Advanced Methods of Teaching Skills and Technical Information (3) Proper selection and effective application of contemporary methods and techniques in the teaching of specialized skills and technical related information.

5510-20-30 Seminar in Industrial Technical Education (3, 3, 3) Ramifications of vocational and technical innovations in trade and industry in relation to an increasingly technically oriented society. Prereq: B.S. in Industrial Education and teaching experience.

5540 New Developments in Industrial Technical Education (3) Prereq: B.S. in Industrial Education plus teaching experience.

School of Health, Physical Education and Recreation

Madge M. Phillips, Director

Graduate programs are available to students preparing for (1) teaching and research positions in colleges, high schools and elementary schools; (2) administrative and supervisory work in athletics, health education, physical education, and recreation; (3) recreation leadership in communities, churches, or agencies; and (4) public health positions in community health education, health planning and administration, and environmental health.

MASTER'S PROGRAM

Four programs leading to the Master of Science degree are available: Physical Education, Recreation, Safety Education, and School Health Education.

Programs leading to the Master of Public Health are also available in Community Health Education, Health Planning, and Environmental Health. Fifty-four quarter hours are required for the M.P.H. degree.

Approximately 23 quarter hours of work selected from courses numbered 5000 and above are included in the Master of Science degree requirements. Course selection shall be made according to each student's professional interests in health, physical education, safety, or recreation with the approval of the major professor. Non-thesis options are available in Physical Education, Recreation, Safety Education, and School Health Education. One full quarter of field practice is required for the Master of Public Health. During field practice, no student shall hold a full-time job except by special permission of the division chairman. Students may be placed in all parts of this country.

The non-thesis degree in Physical Education and in Recreation will consist of a minimum of 45 quarter hours of credit. At least one-half of the total number of quarter hours for the degree must be in courses numbered above 5000.

A three-quarter-hour course in research techniques or statistics or a three-quarter-hour seminar in research will be required. Each non-thesis degree candidate will take a final comprehensive examination.

DOCTORAL PROGRAMS

The Doctor of Education and the Doctor of Philosophy degrees are offered in Health Education, Recreation, Safety Education, and Physical Education.

The Doctor of Education degree is offered with a major in Physical Education and two collateral areas of study. The curriculum to be pursued will be determined by the student and a doctoral committee. Selection of this curriculum will be based on the past training, experience, and interest of the student.

The basic requirements for admission are:

a. A minimum of 40 (physical education) or 50 (health education) quarter hours selected from the following sciences with each area represented: sociology, zoology, physiology, anatomy, psychology, and physical science; also microbiology and anthropology for health education.

b. Submission of satisfactory scores on the aptitude section of the Graduate
Record Examination is required for all doctoral and specialist programs.

- A superior grade point average.
- Submission of satisfactory references relating to training, employment, and character.

Health. Evidence of successful teaching or potential for success in the major area of study.

Graduate Assistantships

A variety of graduate assistantships are offered in Health Education, Physical Education, Safety Education, and Recreation to qualified women and men who are graduates of accredited colleges or universities. These assistantships are open to students in the Master’s and Doctor’s programs.

Assistantships are available by local schools, agencies, and the School of Health, Physical Education, and Recreation in return for part-time services rendered. The services may consist of teaching physical education classes, teaching health classes, teaching safety classes, leading recreational activities, and/or directing or helping to manage extracurricular programs. Students interested in these opportunities should file their applications before February 1. Letters should be addressed to: The School of Health, Physical Education, and Recreation, The University of Tennessee, Knoxville, Tennessee 37916.

Public Health Traineeships

A few Public Health Traineeships are offered for Master of Public Health candidates. These are provided by the United Public Health Service. Letters should be addressed to: Health and Safety Division, The University of Tennessee, 1914 Andy Holt Avenue, Knoxville, Tennessee 37916.

Departments of Instruction

Numbers in parentheses following the course titles indicate quarter hours credit offered.

Division of Health and Safety

MAJORS DEGREES
Health Education Ed.D., Ph.D.
Public Health Education M.P.H.
Safety Education and Service M.S., Ed.S.
School Health Education M.S.

Professors:
- R. H. Kirk (Chairman), H.S.D. Indians; W. J. Huffman, Ed.D. Illinois; R. Kent, Ph.D.

Associate Professors:
- C. B. Hamilton, D.P.H. Oklahoma.

Assistant Professors:
- I. A. Ahmad, Ph.D. Univ. of Oregon;

Lecturers:

The Health and Safety Division offers the following degree programs:

- Master of Public Health degree with a major in Public Health Education. (Major in Public Health Education accredited by American Public Health Association. Options with specialization in Health Planning, Administration or Environmental-Occupational Health and Safety are available.
- Master of Science degree with a major in School Health Education or Safety Education and Service (Thesis and Non-thesis options). Non-thesis option requires 45 quarter hours of coursework.
- Educational Specialist degree in Safety Education and Service.
- Doctor of Philosophy degree in Health Education.
- Doctor of Philosophy degree in Health Education.

Public Health

3000 Foundations of Health Science (3) In-depth study of content areas relating to personal health and contemporary health problems, i.e., mood modifying products, communicable and chronic disease, personal health, practices, reciprocal relationships involving man, disease, and environment.

3210 First Aid and Emergency Care (4) Theory and practice of first aid and emergency care. Instruction in medical self-help. Course leads to Red Cross Certification in Advanced First Aid and Emergency Care. (Applicant must be at least 16 years of age for certification. Same as School Health 3210)

3310 Communicable and Non-communicable Diseases (3) Modern concepts of diseases; etiology of common communicable and chronic disease problems including prevention and control. Preparation for 1 year of biological science and 1 course in bacteriology.

3320 Environmental Health (3) History of the sanitary awakening; disease-producing relationships and controls of water, sewage, refuse, milk, meat and other foods, air, insects, and soil; sanitation of homes, swimming pools, industrial plants, markets, restaurants, camps, and public bathing places. Healthful school living as affected by buildings and grounds, lighting, acoustics, thermal control, and safety provisions. 2 hrs and 1 lab.

4120 Community Health Problems—Alcoholism (3) Explores problems of alcoholism regarding overall health of community. Emphasis placed on factors making alcoholism a serious problem. Various types of educational programs to control the disease covered.

4130 Community Health Problems—Suicide (3) Explores problems of suicide regarding overall health of community.

4140 Community Health Problems—Death Education (3) Exploration of ramifications of death and dying as related to personal and community health.

4210 Urban and Industrial Health (3) Health problems created by a burgeoning population and the megalopolis; industrial health problems of concern to management, supervisor, and industrial worker; control of occupational diseases, poisons, accidents, and other conditions incident to industry.

4220 Communications for Better Health (3) Selective study of communications in the health enterprises. Consideration in logical progression of the problems of transmitting current and new information to practitioners, communications among members of the modern health teams, among health agencies, and the use of mass media for transmitting health information.

4410 Consumer Health and Safety Education (3) Survey of health and safety problems; selecting, purchasing, and financing of safety and medical services.

4411 Instructor’s Advanced First Aid and Emergency Care (3) Designed to teach First Aid. Satisfactory completion qualifies one for American National Red Cross Certification as an Advanced First Aid and Emergency Care Instructor. (Applicant must be at least 21 years of age.) Preference given to First Aid and Emergency Care or valid Advanced First Aid and Emergency Care Certificate.

4420 Drug Abuse Education (3) The drug abuse problem and suspected causes; the pharmacology of drugs and their effects on society and methods of drug abuse education.

4700-10-20 Field Practice in Public Health (3, 3, 3) Practice in public health under supervision of public health professional. S/NC only.

4701 Workshop in Public Health Education (3-4) For teachers, nurses, case workers, sanitarians, and other voluntary and public health agency personnel: emphasizes the problem solving approach and group interaction, case method and critical incident technique. May be repeated.

4840-50-60 Problems in Public Health Education (1, 1, 1) Individual identification and study of current problems in public health education. Extensive reading of literature required.

5010-20-30 Workshop in Public Health (3-6, 3-6, 3-6) Designed to deal with specific public health problems in a short or an extended period of time.

5070-80-90 Field Practice and Seminar in Public Health Education (5, 5, 5) On-the-job field practice under professional and academic guidance in public health or school health education. Seminars scheduled around experiences. S/NC only.

5110 Environmental Health (5) Varied environmental factors within the general framework of air, food, water, shelter, transportation as they affect man’s survival, prevention of disease, performance and enjoyment. Lecture, demonstrations, laboratory and field practice.


5140 Ergonomics and Work in Occupational Health and Safety (3) Study of elements of ergonomics and work as they relate to improvement of occupational health and safety. Lecture, demonstration, laboratory and field practice. Prereq: Consent of instructor.

5210 The Ecosystem of Public Health Education (5) Investigates living and non-living environments, groups and communities therein, and factors causing or influencing in health status. Understandings of human development, behavior, and learning in terms of health education are explored. 4 hrs and 2 labs.

5220 Health and Sickness in the Focus of Public Health Education (2) Formulation of models of positive health within the life cycle and within the life spans of sickness afflicting individuals and groups. 1 hr and 2 labs.

5410 Epidemiology (3) The study of the incidence and prevalence of disease in man.

5420 Administration of Public Health (3) Ad-
ministrative considerations of public health agencies including governmental aspects, legal bases, organizational principles, personnel factors, fiscal management, and public relations.

5430 Vital and Medical Statistics (4) Application of basic statistical principles to living things.

5440 Methods and Materials in Public Health Education (4) Theory and practice in the use of communication techniques and materials in community health education. 3 hrs and 2 labs.

5540 Factors in Problem Solving for Community Health (5) Test skills in communications and group process en route to problem identification, objective setting, problem solving, and planning for health education. 4 hrs and 2 labs.

5550 The Public Health Educator in Community Organization and Development (4) An overview of health organizations and agencies in the community prefaces exploration of conflicting theories and divergent styles of practice in community organization and development. Laboratory to delineate a community near the campus and to practice. 2 hrs and 4 labs.

5560 Functions and Roles of the Public Health Educator (3) Professional scene is examined with special attention to roles and functions. Consideration of philosophy and motivation and differences between health education service and health education program for community learning levels. 1 two-hr lecture-seminar session per week.

5580 Physical Activity and Health (5) (Same as Physical Education 5560.)

5705-95 Advanced Professional Health Education (3-5) Theory and practice in selected areas.

5705 Health Planning I (3-5)

5710 Health Planning II (3-5)

5715 Health Planning III (3-5)

5730 Dental Health Education (3-5)

5735 Emergency Medical Services (3-5)

5745 Family Health Unit (3-5)

5750 Health and Medical Care Legislation and Law (3-5)

5755 Health Facilities Administration (3-5)

5760 Health Services Administration (3-5)

5785 Occupational Health Unit (3-5)

5790 Self-Care Unit (3-5)

5795 The Training of Paramedical Personnel (3-5)


6000 Doctoral Research and Dissertation

6030 Critical Analysis of Writing and Research in Health Education (3) (Same as School Health Ed. 6030.)

6050 Seminar in Health Education (3) (Same as School Health Ed. 6650-60.)

6210 Health Aspects of Gerontology (3)

6220 Seminar on the Nation’s Health (3)

6230 International Health (3)

Safety

3520 Principles of General Safety (3) Deals with the principles, practices, and procedures in general safety. Covers safety problems in school, traffic, recreation, industry, home, and other public areas.


4410 Driver and Traffic Safety Education (5) Preparation of teachers of driver education in schools and colleges. Students are required to teach at least one non-driver. Valid driver's license required. 3 hrs and 2 labs.

4420 Advanced Driver and Traffic Safety Education (5) Development of competence in teaching of driver education through use of simulation, multi-media and multiple-car driving range. Emphasis placed on teaching skills and supervision. Prereq: 4410.

4430 Sports Safety (5) Accident prevention and injury control in sports activities; philosophy of sports medicine; factors and their interrelationship in sports injury and their control; risk-taking and decision solution strategies; and contributions of sports medicine to safety. 3 hrs and 2 labs.

4720 Workshop in Safety (3-6) Deals with special safety education problems. For advanced undergraduate students, graduate students, teachers, supervisors, and administrators. May be repeated.

5000 Thesis

5320 Behavioral Problems in Safety Education and Accident Prevention (3) Problems of behavior, causes of accidents, and the application of the principles of psychology in the development of safe behavior in all segments of our environment.

5330 Problems and Research in Accident Prevention (3) Analysis of safety problems found in a wide variety of accidents that occur in the community; the findings of current research in the behavioral sciences as related to variation in the incidence of accidents.

5340 Organization, Administration, and Supervision of Safety Programs (3) National, state, and local level programs including administrative, instructional, and supervisory aspects. Basic emphasis on implementation of relevant programs.

5350 Civil and Defense Education (3) In-depth study of civil and defense problems; tornadoes, floods, fires, mass civil disorders, and nuclear and personnel attack by alien countries.

5720-30-40 Graduate Workshop in Safety (3-6, 3-6, 3-6) Deals with specific safety problems. Designed especially to explore special safety problems in a concentrated period of time.


5870-80-90 Current Issues in Safety Education (1, 1, 1)

6010-20-30 Internship and Research in Safety (3, 3, 3) Designed to allow the student opportunities for engaging in field experience to the end that a significant problem in that experience will be identified, researched, and reported on in acceptable form.

School Health

3210 First Aid and Emergency Care (4) (Same as Public Health 3210.)

3410 School Health Instruction (3) Selection of health content in the school curriculum.

3420 School Health Services (3) Development, maintenance, and protection of the health of students including examination, screening, special services, communicable disease control, emergency care, and school health records.

3510 The School in Community Health (3) Role of the teacher in community health education; the school's responsibility in promoting healthful living and the place of existing media and agencies in the program. Not open to health and physical education majors.

3610 Methods in Elementary Health Instruction (3) Preparation and presentation of health topics. Teaching method is emphasized and student participation stressed. Required for elementary teachers. Prereq: 3510 or Principles of Personal Health or Elementary Nutrition.

3620 The Teaching of Sex Education (3) Trends, content, methods and materials in sex education.

3650 Methods in Secondary Health Instruction (3) Preparation and presentation of health topics. Teaching method is emphasized and student participation stressed. Required for secondary health certification. Prereq: 3410 or Principles in Personal Health or Elementary Nutrition.

4710 Workshop in School Health Education (3-6) For advanced students, teachers, school administrators, nurses and other paramedical school personnel. Lectures, demonstrations, films, field trips, and supervised research in special school health problems. May be repeated.

4810-20-30 Problems in School Health Education (1, 1, 1) Individual identification and study of current problems in a concentrated period of time. Extensive reading of literature required.

5000 Thesis

5101 Problems and Practices in School Health (3) Comprehensive study and analysis of the principles, problems, systems, and trends of health and in school health.

5510 Curriculum Construction in School Health Instruction (3) An analysis of school health instruction programs in the elementary and secondary schools. Stresses the planning and construction of health curricula to meet the needs, interests, and abilities of pupils.

5520 Evaluation in School Health Instruction (3) Principles of objective tests construction; the place of behavior and attitude scales, check lists, questionnaires, surveys, and inventories in the evaluation of health instruction. Includes criticism of several commercially prepared tests and construction and standardization of a test.

5530 School Health Program Surveys (3) Stresses the techniques and standards used in making a survey of a school health program; examines the relative contribution of health instruction, health services, and healthful environment as each contributes to the well being of individual students. Includes a survey of an existing school health program.

5620 School Health Administration and Supervision (3) Analysis of various types of administrative control; budgetary problems; the education-public health dilemma; responsibilities of school health personnel. Resource materials include case studies of on-going school health programs.

5630-40 Workshop in School Health Education (3, 3) Designed for graduate students, inservice teachers, and other health professionals. Emphasis in any workshop to be placed on one critical health issue.

5720-30-40 Graduate Workshop in Health Education (3-6, 3-6, 3-6) Deals with specific health problems. Designed especially to explore special health problems in a concentrated period of time.


6000 Doctoral Research and Dissertation
Division of Physical Education

MAJOR

Physical Education

DEGREES

M.S., Ed.D.

Professors:


Associate Professors:

E. T. Howley, Ph.D. Wisconsin; N. E. Lay, Ph.D. Florida State; B. J. Mead, Ph.D. Purdue; H. G. Welch, Ph.D. Florida.

Assistant Professors:


The Physical Education Division offers the following degree programs:

Master of Science degree in Physical Education (thesis and non-thesis programs)

Doctor of Education degree in Physical Education

Physical Education Major

3050 Rhythmic Analysis (2) Emphasis on the analysis of organic movement. Prereq: Consent of Instructor.

3090 History of Dance and the Related Arts (2) Study of the history of dance in relation to other art forms.

3151 History of Dance and the Related Arts II (1) Survey of dance and the arts related to it tracing their development in the twentieth century.

3310 Tests and Measurements in Physical Education (3) Study of elementary statistics relating to measurement. Critical examination of tests used to evaluate strength, sport skills, and physical fitness.

3430 Adaptive Physical Education Laboratory (1) Practical work, including student teaching, supplementing 4110.

3710 Camping (2) Theory and practice in leadership with practical experience in camp craft skills. Not for graduate credit for Physical Education majors.

3880 Social Recreation (3) Theory and practice in social recreation for camps, community centers, clubs, and schools. Course includes folk and square dance, quiet and active games, skills, stunts, other recreational activities, and program planning. Not for graduate credit for Physical Education majors. (Same as Recreation 3880).

4001 Stage Movement (3) Theory and practice in stage movement for actors and dancers. Styles of movement, character and moral movement and combat.

4010 Advanced Dance Technique (2) Development, integration, and synthesis of previous dance vocabulary; emphasis on analysis and practical applications of dance technique. Prereq: Consent of instructor.

4020 Practicum in Dance Production (2) Prereq: Consent of instructor.

4060 Advanced Dance Composition (2) Creation and development of ideas, themes, and dance forms; solo and group work. Prereq: Beginning Dance Composition.

4070 Stagecraft for Dance Production (2) Equipment, light design, properties, sets, and stage management. Lab.

4110 Adaptive Physical Education (3) Classification of atypical students who require modified programs in physical education; activities and class organization suitable for required or special physical education classes.

4150 Creative Rhythms for Children (3) Methods and materials for grades 1-6. 3 hrs and 1 lab.

5000 Thesis

5110 Administrative Problems in Health and Physical Education (3)

5120 Problems of the Curriculum in Health and Physical Education (3)

5130 Methods in Physical Education (3) Characteristics of different school age levels, and applications of learning procedures in physical activities at those levels.

5210 Principles and Philosophy of Physical Education (3)

5220 Readings in Physical Education (3) A comprehensive review of literature in physical education and related areas.

5230 Supervisory Problems in Physical Education (3) For students interested in supervision of physical education teachers.

5310 Analysis of Basic Motor Skills (3) Mechanical analysis of basic motor skills, emphasizing application of these skills to physical education and athletics.

5320 Seminar in Research Techniques in Physical Education (3) An evaluation of appropriate research techniques in physical education.

5410-20-30 Specialization Study in a Selected Physical Education Area (1-3, 1-3, 1-3) Advanced comprehensive study in a specialized area within the general fields of physical education. Prereq: Consent of instructor. S/NC only.

5500 Advanced Kinesiology (3) Action of muscles involved in fundamental movements, calisthenics, sports, and gymnastics. Prereq: Applied Anatomy and Physiology or equivalent.

5510 Selected Topics in Anatomy (3) Intensive study of various systems of the human body. Prereq: 5550 or equivalent. May be repeated with consent of instructor. S/NC only.

5550 Physical Rehabilitation (3) Comprehensive study of physical disabilities and rehabilitation techniques. Prereq: 5500 or equivalent.

5580 Physical Activity and Health (5) Research evidence of the relationship of physical exercise to the following: longevity, weight control, cardiovascular diseases, low back pain and other disorders, mental health, growth, and aging. Applications for the maintenance of health will be emphasized. Prereq: Course in Physiology of Exercise or consent of instructor. 5 lectures per week. (Same as Public Health 5580).

5620 Applied Physiology (6) Principles of Physiology with special emphasis on the application of physiological findings to practical problems related to human function. Prereq: 1 year General Chemistry, or consent of instructor.

5610 Advanced Exercise Physiology (4) Principles of energy transfer in man with special emphasis on the integration of organ systems in adapting to the requirements of muscular exercise. Prereq: Zoology 4940 or equivalent.

6030 Critical Analysis of Writing and Research in Health Education (3) (Same as Public Health 6030.)

6050-60 Seminar in Health Education (3, 3) (Same as Public Health 6050-60).

College of Education 61

Division of Recreation

MAJOR

Recreation

DEGREE

M.S.

Professor:

G. F. Brady, Ph.D. Iowa

Associate Professor:

M. L. Peters (Chairman), Ph.D. Illinois

Assistant Professor:

P. A. Boroviak, M.S. Tennessee; C. J. Johnson, M.S. Tennessee.

The Recreation Division offers the following degree program:

Master of Science degree in Recreation (thesis and non-thesis programs)

3100 Recreation Leadership Procedures (3) Principles and practice of recreation leader-
ship; techniques and methods of working with individuals and groups in leisure activity.

3140 Philosophical Foundations of Recreation (3) Examination of recreation as personal experience; theories of play; philosophies of leisure and relationship to economy, ecology, health, government, culture, and self-realization; history of recreation movement.

3200 Planning Leisure Programs (3) Principles and methods employed in planning effective and well-balanced leisure time programs for varied groups in various settings.

3880 Social Recreation (3) (Same as Physical Education 3880.)

4130 Recreation Administration (3) Introduction to recreation administration, including planning, personnel, areas and facilities, program services, finances, and public relations. Prereq: Orientation to the Recreation Profession, 3100, 3140, or consent of instructor.

4200 Survey of Recreation for Special Populations (3) Responsibility of recreation profession to minority groups whose leisure opportunities and needs may require special servicing.

4500 Specialized Study in a Selected Area of Recreation (1-9) Comprehensive study in a selected specialized area within the broad field of recreation. For recreation students only. May be repeated with consent of the division. Maximum 9 hrs.

5000 Thesis

5140 Leisure Service Delivery Systems (3) An in-depth study of the various systems—public, private, and commercial—involved in the provision of leisure services for the community at large. Prereq: Consent of Instructor.

5150 Current Issues in Recreation (3) Identification and consideration of some of the broad issues—social, environmental, ethical, etc.—which currently have the greatest impact on people's use of leisure, and implications for the recreation administrator. Prereq: Consent of Instructor.

5240 Therapeutic Recreation (3) Concerned with the role of recreation in the lives and treatment of persons with disabilities—mental, physical, and medical. Considers possibilities for helping the ill and disabled realize their fullest potential. Prereq: Consent of Instructor.

5300 Seminar in Recreation (1) Presentation and general discussion of students' research studies, projects, and theses in recreation. Prereq: Consent of Instructor. May be repeated. Maximum 6 hrs. S/NC only.

5440 Problems and Projects in Recreation (1-9) Individual research on a problem of special significance to the student. Research projects of a limited nature undertaken in lieu of thesis. May be repeated. Maximum 9 hrs. A new problem must be undertaken for each repetition.

5450 Specialized Study in Recreation (1-9) Advanced comprehensive study in a selected specialized area within the leisure and recreation field. Prereq: Consent of Instructor. May be repeated. Maximum 9 hrs.
College of Engineering

F. N. Peebles, Dean
W. K. Stair, Associate Dean
W. A. Miller, Assistant Dean

Graduate degree programs of the College of Engineering provide opportunities for advanced study leading to the Master of Science degree and the Doctor of Philosophy degree. For a listing, consult Majors and Degrees Available on page 8.

OFF-CAMPUS GRADUATE INSTRUCTION BY VIDEOTAPE-ELECTROWRITER

Since 1966, the College of Engineering has made use of electronic communication techniques to reach students beyond the confines of Knoxville classrooms. These remotely-taught classes make the specialized talents of Engineering College faculty available to students at off-campus centers and industrial sites. This effort makes use of video tapes prepared from a regular on-campus class in a specially-equipped classroom. The tapes contain a visual and audible record of a professor’s lecture and discussions with his on-campus class. When the tapes are played back at remote locations, telephone/Electrowriter contact is established between the professor and the off-campus class to allow full discussion and questions before or after a tape is played. Periodic visits by the professor are made to each remote class.

Graduate courses have been offered to students at other campuses and established centers of the UT System (Chattanooga, Kingsport, Martin, Memphis, Nashville, and Tullahoma). A limited number of graduate courses have also been made available to engineers in industrial plants. Such courses are also offered to students using classroom facilities at Jackson State Community College and Columbia State Community College.

The remotely-taught courses offered by UTK carry full graduate credit toward the master’s degree under authorization of the regional accrediting agency, the Southern Association of Colleges and Schools.

YEAR-IN-JAPAN M.S. PROGRAM

This is a unique program for allowing American engineering students to develop some understanding, both scientific and cultural, of Japan. It allows an M.S. candidate to obtain his degree from UTK while carrying out his research work at a Japanese university. The program requires approximately two years, one year being spent in Japan and the remaining period being spent at UTK to fulfill the course requirements and to write the thesis or project report, as appropriate to the particular department. The program is administered in the framework of each department’s regular graduate program excepting that the research is done in Japan.

Although the language of communication in Japan would be English, cultural understanding is one of the important objectives of the program and as such a participant would be asked to make a beginning at Japanese language study. At the option of the department, up to six hours of graduate credit may be allowed for language study, either at UTK or in Japan.

Financial support for living expenses in Japan and for the roundtrip transportation can usually be arranged through fellowships from the Japanese Ministry of Education.

Engineering Experiment Station

F. N. Peebles, Director
W. K. Stair, Associate Director

The Station is organized to conduct investigations in fundamental engineering science and to aid in the development of the state’s resources and industries insofar as funds available will permit.

The Station may also make special arrangements with any person or company to study any technical question within the capacity of its resources, and to report the results exclusively to the company requesting the study. In such case, the whole expense will be carried by the parties requesting the investigation.

Engineering Administration

MAJOR
Engineering Administration

DEGREE
M.S.

Committee:
H. L. Loveless, Chairman
J. F. Bailey
F. A. Chamblin
D. W. Cravens
G. E. Nichols
W. G. Sullivan
R. L. Young

A program of study leading to the degree of Master of Science with a major in Engineering Administration is offered. This program is aimed at providing education for graduate engineers in the organization and direction of work in engineering functions, at a level which requires understanding of such areas as marketing, finance, and industrial relations. It should be emphasized that this is an engineering program, aimed at preparing individuals for line management positions.
in construction, design, development, manufacturing, etc. where both technical and non-technical factors exert significant influence on the success of a given activity. The program does not provide the opportunity for in-depth study of any of the traditional areas of business administration, and students with such interests are advised to consider graduate programs available in the College of Business Administration.

To be admitted to the Graduate School as a potential candidate for a Master's degree with a major in Engineering Administration, the applicant must submit reasonable evidence of ability to pursue graduate studies at an acceptable level of performance. In general, the applicant should have graduated from a recognized undergraduate institution in engineering with a satisfactory grade point average. In addition, applicants must satisfy one of the following experience requirements: (1) at least two years of engineering experience after graduation if a full-time student or (2) current employment in engineering work if a part-time student.

THE MASTER'S PROGRAM

Minimum requirements for the Master's degree are the satisfactory completion of the following courses:

1. An Engineering Core, 27 hours of graduate credit consisting of Engineering Administration 5900, at least three courses chosen from Industrial Engineering 4150, 5100, 5520, and 5710, and a complement of engineering courses normally selected from the student's undergraduate major department or from courses of other departments pertinent to the program.

2. A Business Administration Core, 15 hours of graduate credit consisting of Accounting 5810, Finance 5050, Marketing 5050, Industrial Management 5130 or Transportation 5210.

3. General Electives, nine hours of graduate credit chosen from computer science, economics, engineering, management science, mathematics, psychology, statistics, and other program-related disciplines.

The program requirement totals 51 hours of graduate course credit. No thesis is required. The final oral and written examination must be passed on the work offered for the degree. Course prerequisites for the program are Accounting 5050 (or 2110), Computer Science 3150, Industrial Engineering 4520, and Statistics 3450 or their equivalents. None of these prerequisites may be counted as part of the 51 hours of credit offered for the degree. These course prerequisites will be waived upon presentation of evidence of competency in the course subjects. Other prerequisite courses may be required, depending upon the student's background and the electives chosen.

5900 Project in Engineering Administration (3) An in-depth study and formal report of an engineering administration topic, normally performed during the last quarter of work toward degree. For M.S. in Engineering Administration candidates only. May be repeated. Maximum of 3 hrs credit to be applied toward degree. Must register for 5900 until project is complete. S/NC only.

Departments of Instruction

Numbers in parentheses following the course titles indicate quarter hours credit offered.

Chemical and Metallurgical Engineering

MAJORS DEGREES

Chemical Engineering M.S., Ph.D.
Metallurgical Engineering M.S., Ph.D.

Professors:

H. F. Johnson (Head), D.Eng. Yale;
D. C. Bogue, Ph.D. Delaware;
B. S. Borie, Ph.D. Massachusetts Institute of Technology; D. R. Brooks, Ph.D. Tennessee;
E. S. Clark, Ph.D. California (Berkeley);
L. W. Crawford;*
G. O. Cubbon, Ph.D. Texas;
H. H. Shu, Ph.D. Wisconsin;
S. H. Jory, Ph.D. Cincinnati;
C. D. Lindsell, Ph.D. Pennsylvania;
C. J. McEvedy, Ph.D. Kentucky;
B. F. Oliver, Ph.D. Pennsylvania State;
J. R. Prorok, Ph.D. Northwestern;
J. D. Seaton, Ph.D. Tennessee;
J. E. Spruiell, Ph.D. Tennessee; E. E. Stansbury; Ph.D. Cincinnati; J. L. White, Ph.D. Delaware; M. A. Wright, Ph.D. California (Berkeley);

Associate Professors:

W. T. Becker, Ph.D. Illinois; J. F. Fellers, Ph.D. Akron; G. C. Frazier, Ph.D. Johns Hopkins; J. M. Holmes, Ph.D. Tennessee;
C. F. Moore, Ph.D. Louisiana State; R. A. Vandermeer, Ph.D. Illinois Institute of Technology;
J. S. Watson, Ph.D. Tennessee.

Lecturers:

D. L. Mcelroy, Ph.D. Tennessee; T. D. Parsh, Ph.D. Rice; B. Pilling, Ph.D. Leeds (England);
W. H. Seaton, Ph.D. Ohio State; E. von Halle, Ph.D. Tennessee.

M.S. PROGRAM

Minimum departmental requirements include the satisfactory completion of:

1. A major consisting of 18 to 27 quarter hours of graduate courses in chemical engineering or metallurgical engineering.
2. One or two minors, nine to 18 hours in total, either in chemical or metallurgical engineering, chemistry, mathematics, physics, engineering, or other related fields.
4. Active participation in graduate seminars in the department. Resident students must register for Chemet Engineering 5010 every quarter offered.
5. Final examination covering thesis, related fields, and graduate course work.

DOCTORAL PROGRAM

Students applying for entrance into the doctoral program must display concrete evidence of previous research and capability to perform independent research to the satisfaction of the department. The Master's thesis may be offered as such evidence.

Department requirements consist essentially of the satisfactory completion of:

1. Graduate courses in chemical engineering or metallurgical engineering amounting to approximately 36 quarter hours, at least 12 of which must be in 6000 series courses.
2. Supporting courses in related scientific and engineering fields amounting to approximately 36 quarter hours, subject to approval by the student's faculty committee. These related fields will normally include chemistry, mathematics, physics, and civil, electrical, industrial, mechanical or nuclear engineering.
3. The preliminary examination, usually given in two parts, and covering such material as chemical and metallurgical engineering operations and processes, thermodynamics, fluid mechanics, heat transfer, technology, mathematics, physics, theoretical chemistry, and other related fields.
4. Active participation in graduate seminars conducted by the department. Resident students must register for Chemet Engineering 5010 every quarter offered.
5. Reading knowledge of a foreign language relevant to the candidate's research program; selection of language to be made in consultation with the faculty committee.

PROGRAM OPTIONS IN POLYMER SCIENCE AND ENGINEERING

M.S. and Ph.D. degrees with specialization in polymer science and engineering are possible through two routes—one in the department with an engineering emphasis and a second in a joint program with the Chemistry Department having a chemical emphasis.

The specialization program in this department requires, for the M.S. degree, a thesis in the field, completion of Ch.E. 4910, 4920, 5640, 5660 and either 5650 or 5820 plus active participation in the Polymer Seminar. The Ph.D. candidate must meet the above requirements, pass a special written examination in polymer science and engineering, and complete an additional academic program to be specified by the student's committee.

M.S. and Ph.D. degrees in the joint specialization program with the chemistry department require a thesis or dissertation in the field. Chemical and metallurgical engineering departmental requirements include completion of Ch.E. 4910 and 4920, Chemistry 5531 and 5140, plus active participation in the Polymer Seminar. Ph.D. students must also pass a special written examination as well as complete the above requirements.

Chemet Engineering

5010 Graduate Seminar (1) May be repeated. Prereq: Admission to graduate program.

Chemical Engineering

3410 Flow of Fluids (4) Differential and overall momentum balances, mechanical energy balances; flow in tubes, piping systems, and packed beds; metering devices, pumps, Prereq: Elementary Linear Algebra and Calculus of Several Variables, and Mass and Energy Relations. 3 hrs and 1 lab.

3420 Heat Transfer (4) Differential and overall
energy balances; steady and unsteady state heat conduction in simple geometries; heat transfer in tubes and heat exchangers; condensation, boiling, radiation. Prereq: 3410. Introduction to Differential Equations. 3 hrs and 1 lab.


4340 Stagewise Operations (3) Analytical and graphical methods applied to stage wise separative operations. Prereq: 3440.

4350 Diffusional Operations (3) Diffusion, simultaneous heat and mass transfer; applications of vector and matrix algebra, gas absorption, extraction. Prereq: 3420.

4360 Process Dynamics (3) Quantitative treatment of dynamic nature of physical processes. Linear systems and differential equations. Place transfer transforms. Block diagrams, algebra, and transfer functions of systems, process simulation. Mathematical models for several chemical processes will be developed and analyzed in detail. Prereq: Introduction to Differential Equations.

4360 Chemical Process Control (3) Basic control theory applied to chemical processes; feedback control system, cascade control, feed forward control, stability analysis, root locus and Bode analysis. Modern industrial control hardware and instrumentation. Prereq: 3610.

4110 Chemical Engineering Data Analysis (3) Analytical and experimental identification of system extremals; statistical properties of samples and source systems; empirical modeling of processes; statistical process control. Prereq: Math 3150.


4130 Introduction to Optimization (3) Principles and applications of various optimization techniques to chemical process design; unconstrained optimization, equality constrained optimization, inequality constrained optimization, applications of vector and matrix algebra. Prereq: Consent of instructor.


4150 Process Design and Economic Analysis (3) Development of basic information on a process into an integrated plant design considering mass and energy balances, product specifications, equipment characteristics, capital investment, operating costs and economic merit. Prereq: 4410, 4530.

4430 Special Problems in Design and Economics (3) Extension of 4420 for student participation in the A.I. Ch.E. annual contest problem; other advanced design projects. Prereq: 4420.

4530 Chemical Engineering Reaction Kinetics (3) Chemical reaction rates in closed and flow systems; interpretation of laboratory and pilot plant data; reactor design. Prereq: 3420-30, Chemistry 3430.


4620 Control of Complex Chemical Processes (3) Analysis of nonlinear systems, stability considerations for design of an integrated control system for a complete chemical process. Prereq: 3620.

4660 Hydrocarbon Processing (3) Study of specialized characterization of physical properties of fossil fuel raw materials and products, and of processes for conversion of fossil fuel raw materials into products needed in industrial energy, industrial raw material and consumer markets. Prereq: 3440.

4710 Advanced Transport Phenomena (3) An Introduction to molecular theories for predicting transport properties; development of the equation of state and mass transfer; and selected applications in laminar flow; generalized correlation methods. Prereq: 3450.

4730 Mass and Energy Flow in Biological Systems (3) Basic and organismal principles applicable to biological systems. Derivations of general equations of bio mass and energy transfer and equilibria for transport and equilibrium in biological systems. Discussion of Volterra's equation and biological clocks. Prereq: Consent of instructor.

4740 Introduction to Transport Phenomena in Biological Systems (3) Application of principles of transport phenomena to biological systems. Transfer of chemical energy and various cellular active transports; structure and rheology of physiological fluids, membrane and interfacial phenomena; analysis and design of artificial organs. Prereq: 3440, 3450 or consent of instructor.

4750 Microbiological Process Engineering (3) Application of chemical engineering principles and design concepts to microbiological processes; continuous culture of microorganisms, food processing and pharmaceutical processes. Prereq: 3440, 3450 or consent of instructor.

4760 Principles of Biochemical Separation (3) Physical aspects and similarities of modern biochemical separation methods; laboratory demonstrations, design of production and analytical systems.

4770 Chemical Bioengineering Laboratory (3) Laboratory investigations of controlling factors in biochemical engineering operations: Liquid chromatography, continuous microbial growth and handling, preparatory zonal centrifuge and electrophoresis, etc. Prereq: 4740, 4750, and 4760 or consent of instructor.

4781-82-83 Topics in Biochemical Engineering (3, 3, 3) Problems of current interest in biochemical engineering. Prereq: Consent of instructor.

4810-20-30 Special Problems in Chemical Engineering (3, 3, 3) Chemical engineering problems related to recent developments in industrial practice. Prereq: Consent of instructor.

4910 Applied Polymer Science (3) A first course in the physical properties of polymers. Polymer structure, crystalline and glass transitions, physical properties of amorphous and crystalline polymers, crystallization kinetics and mechanical properties are discussed. Prereq: Process Principles and Materials III.

4920 Polymer Processing (3) Rheological properties of polymer melts and solutions, viscometry, unit operations of fiber, plastics, and rubber. Dimensional analysis and scale-up, flow through dies and pipelines, screw extrusion, spinning of fibers, injection molding. Prereq: 3420, Process Principles and Materials III or equivalent.

4930 Principles of Fiber and Textile Engineering (3) Chemical and crystalline structure of important fibers; melt, wet and dry spinning of man-made fibers; characterization of yarn preparation of yarn; dyeing, weaving and knitting. Emphasis on quantitative aspects. Prereq: Met. Engr. 3110 or equivalent.

4940 Plastics Fabrication Operations (3) Lecture and laboratory course treating unit operations involved in the Types of operations used. Prereq: Consent of instructor.

College of Engineering 65

Operations to include: extrusion, co-extrusion, injection molding including structural foam, thermoforming, blow molding, rotational molding, etc. Prereq: 3420 or equivalent.

5000 Thesis

5111 Chemical Engineering Analysis (3) Mathematical formulation and solution of differential equations for typical chemical engineering systems, especially those of heat and mass diffusion; transform methods, classical solution techniques, conformal mapping. Prereq: Differential Equations.


5120 Heat Convection (3) Analysis of heat convection in fluids under viscous and turbulent flow conditions, emphasizing analytical approach; simulation of diffusion of momentum and heat. Prereq: 5111.

5130 Methods of Optimization (3) Principles and applications of various mathematical programming techniques to chemical process design and control; variational method, maximum principle, dynamic programming, and geometric programming. Prereq: 4130.

5210 Process Dynamics (3) Generalized analysis of recycle operations, steady state simulation and optimization of typical processes.

5250 Chemical Process Industry Economics (3) Analysis of the economic components of chemical processes, of the internal economics of the chemical enterprise, and of decision making for investment in capital facilities. Prereq: 4120-30, 4420.

5310 Thermodynamics of Heterogeneous Equilibrium (3) Phase rule; equilibrium between phases; composition relationship between phases; ideal and non-ideal solutions. Prereq: 3430 or equivalent.

5320 Statistical Thermodynamics (3) Basic concept of statistical mechanics and application to evaluation of thermophysical properties. Prereq: 5310.

5410-20-30 Research and Design in Chemical Engineering (3, 3, 3) Chemical engineering research projects; interpretation of laboratory data and design of experiments in chemical engineering research.

5510 Chemical Reactor Design (3) Non-ideal flow patterns in chemical reactors; diffusion and reaction in two phase systems; introduction to heterogeneous catalysis and reactor stability. Prereq: 4530.

5610 Stagewise Mass Transfer Operations (3) Equilibrium stage, concepts applied to mass transfer operations, emphasizing non-isothermal and multicomponent systems.

5620 Differential Mass Transfer Operations (3) Differential mass transfer operations; falling and scale-up, flow through dies and pipelines; non-isothermal and multicomponent systems; current theories of mass transfer; heat and momentum transfer analogies. Prereq: Differential Equations.

5640 Structural Characterization of Polymers (3) Experimental methods of determining the nature of transitions and structural characteristics of polymers most pertinent to plastics, fibers, and rubber applications. Methods of determination of tactility, crystalline structure, orientation, morphology, etc., including x-ray diffraction, nuclear magnetic resonance, and electron microscopy. Prereq: 4910 or equivalent.
66 College of Engineering

(3) Application of linear viscoelasticity and large deformation elasticity to solid polymer (especially, vulcanized rubber) and other (polymer) properties. Topics include dynamic modulus and loss tangent, wave propagation, friction, tensile, tear, etc. Theoretical and experimental methods of determining properties. Prereq: 4920, 5640, or equivalent. (Same as Met. Engr. 5650.)

5660 Polymer Solution Properties and Characterization (3) Evaluation of properties of isolated chains, polymer solutions and bulk polymers, lattice theory of polymer solutions and prediction of phase equilibrium, phase transitions, kinetic theory of rubber elasticity. Prereq: 4910, 5320 or equivalent.

5690 Modern Research Tools and Instruments for Polymer Science (3) Laboratory course in methods of characterization of polymers: includes gel permeation chromatography, intrinsic viscosity, spectral analysis, measurement of polymer properties, calorimetry, and dynamic mechanical measurements. Coreq: 5660.

5810 Mechanics of Viscous Flow (3) (Same as Engr. Mech. 5220.)

5820 Non-Newtonian Fluid Mechanics (3) Tensor analysis; generalized equations of motion; survey of non-Newtonian technology. Prereq: 5810 or equivalent. (Same as Engr. Mech. 5230.)

5910-20-30 Selected Topics in Polymer Science (3, 3, 3) Advanced problems in modern polymer science. Students should consult the director of the course in advance. Prereq: 4910, 4920 or equivalent. (Same as Chem. 5150-60-70.)

5940 Industrial Chemistry of Polymers (3) Mechanisms and reactions of polymers including oxidation and degradation. Modifications of polymer systems. Prereq: Chemistry 5531 or equivalent.

6000 Doctoral Research and Dissertation

6130 Process Optimization (3) Optimization of chemical process equipment and systems by various techniques; static and dynamic systems. Prereq: 5130.

6210 Advanced Diffusional Operations (3) A study of fixed and fluidized bed operations utilizing the stagewise and differential mass transfer bed concepts. Prereq: Consent of instructor.

6250 Venture Analysis in the Process Industries (3) The interactions among the line functions of a typical chemical company in the application of modern decision theory and mathematical models to achieve an optimum product investment decision in the face of external competition. Prereq: 5250.

6310 Thermodynamics of Irreversible Processes (3) Thermodynamic treatment of irreversible chemical processes, transport processes, coupling phenomena, etc., with special emphasis on topics and methods of interest to engineers and bioengineering students. Prereq: 5310.


6360 Advanced Continuum Mechanics (3) A survey of the theoretical foundations of continuum mechanics, with special emphasis on comparing the classical mechanics of fluids and of elastic solids; classification and comparison of several selected applications, especially in fluid viscoelasticity. Prereq: 5820 or Engr. Mech. 5410 or Met. Engr. 5840 or consent of instructor. (Same as Engr. Mech. 6800.)


6420 Stability Phenomena in Chemical Engineering: Continuous Systems (3) Hydrodynamic instability and linear instability in fluids based on interaction of fluid dynamic phenomena with heat transfer, diffusion and chemical reactions. Emphasis on formulation of problems and methods of solution. Typical applications include stability of jets and formation of emulsions, Benard instability, Marangoni turbulence. Prereq: 5810 and 5620 or equivalent.

6510 Applied Chemical Reaction Kinetics (3) Chemical reactions in both gas and liquid phases as well as heterogeneous catalysis, catalytic combustion, radiation chemistry. Emphasis is on development of a phenomenological description although mechanistic models are discussed. Prereq: 5510.

6520 Catalytic Reactor Design (3) Principles of kinetic, heat and material transfer to the design and analysis of heterogeneous catalytic reactors. Prereq: Consent of instructor.

6710 Process Dynamics (3) Development of dynamic models of process equipment from conservation and rate laws; testing of models by frequency, step, and pulse response methods. Prereq: Consent of instructor.

6810 Advanced Methods in Polymer Processing (3) Application of theories of rheological properties and structures formation to analysis of polymer process operations. Prereq: 5820.

6920-30-40 Recent Advances in Polymer Science and Engineering Technology (3) Fabrication methods and properties of latest developments in science and technology of polymers. May include topics of morphology, structure, characterization, etc. Prereq: Consent of instructor.

6950 Advanced Industrial Polymer Chemistry (3) In-depth treatment of chemistry and properties of new polymeric engineering materials; highly integrated, engineering and chemical approach is used. Prereq: 5940 or consent of instructor.

6960 Polymerization Methods Using Organometallic Catalysts (3) The syntheses, reactions, reaction mechanism studies, and modifications of highly controlled polymer structures will be presented. Organometallic catalytic activities as they relate to polymers, etc., will be discussed. Prereq: 5940.

Metallurgical Engineering

3110 Engineering Materials I (4) Introductory course correlating the atomic, crystal, and micro-structure of solids with mechanical, physical, and electrical properties; control of engineering significance. 3 hrs and 1 lab.


3150 Engineering Materials V (3) Extension of 3110 with emphasis on the mechanisms and control of reactions of engineering materials with aqueous, non-aqueous, and gaseous environments. Prereq: 3110.


3210 Plastic Deformation (4) Phenomena and theoretical plasticity of flow in engineering line materials. Applicable concepts of crystallography and x-ray diffraction; use of stereographic projections. Prereq: 3110. 3 hrs and 1 lab.

3220 Diffusion and Annealing (3) Introduction to solid state kinetics; point defects, solid solutions, diffusion equations and mechanisms, annealing of cold worked structures. Prereq: 3210. Coreq: Introduction to Differential Equations.

3230 Phase Transformations (4) Thermodynamic and structural factors governing binary equilibrium. Teriary systems. Kinetics and morphology of precipitation and phase transformations in simple and complex systems. Prereq: 3220. 3 hrs and 1 lab.

3310 Biomedical Applications of Materials for Life Scientists (3) Principles of engineering materials; metals, polymers and ceramics; methods of fabrication of components; corrosion applications of prosthetic devices and dental materials. Prereq: General Chemistry or equivalent.

3520 Materials Behavior and Chemical Process Equipment Design (3) Mechanical, metallurgical and chemical considerations in design of chemical processing equipment: Process Principles and Materials III or equivalent; 3150; and Chemical Engineering 3420. (Same as Engineering Mechanics 3520.)

3710 Metallurgical Applications in Manufacturing Technology (3) Fabrication methods and principles of mechanical/thermal processing for finished and semi-finished articles; casting, powder metallurgy, plastic forming, joining, heat treatment. Prereq: Engineering Mechanics I or equivalent.

4240-50 Design and Analysis (3, 3) Design and laboratory sessions on the analysis of materials requirements and polymerized engineering structures and components. Coreq: 4740. 3 labs.

4510-20 X-Ray Diffraction and Crystallography (3, 3) Lecture and laboratory work in crystallography, x-rays, diffraction phenomena and techniques, introduction to structure determinations. The first quarter serves as an introduction to the subject. 2 hrs and 1 lab.

4540 Fracture-Safe Design (3) (Same as Engineering Mechanics 4540.)

4610 Physical Properties of Materials (3) Introduction to electron theory of solids, types of bonding in solids; thermal, electrical and magnetic properties of materials; relationship
between metallurgical structure and properties. Prereq: Physical Metallurgy II. 3 hrs or 2 hrs and 1 lab.

4710 Production Metallurgy (3) Thermodynamic and kinetic principles of roasting, smelting, refining.

4730 Mechanical Metallurgy I (3) Elastic behavior. Description of stress, strain, and elastic constitutive relations. Effects of composition, impurities of fabrication, forging, swaging, extrusion, rolling, deep drawing. Prereq: 4730 or consent of instructor. Also suggested for mechanical engineering, engineering mechanics, or engineering science students. 3 hrs or 2 hrs and 1 lab.

4740 Mechanical Metallurgy II (3) Ductile and brittle fracture, creep and stress rupture, fatigue, and residual stresses. Effects of state of stress, loading rate, time, temperature, and metallurgical structure. Prereq: 3120 or 3230, and 4730 or M.E. 3650 or consent of instructor. Also suggested for mechanical engineering, engineering mechanics, or engineering science students. 3 hrs or 2 hrs and 1 lab.

4760 Casting and Welding (3) Principles and processes of casting and welding: Heat transfer, solidification, segregation, gas-metal and slag-metal interactions, thermal treatments, associated stresses. Prereq: 3230, 3 hrs or 2 hrs and 1 lab.


5410-20-30 Advanced X-Ray Diffraction (3, 3, 3) Review of mathematical techniques; generalization of crystallography, x-rays, properties of single and polycrystalline materials; and X-ray analysis of point defects and cold work.

5540-50 Electron Microscopy I and II (3, 3) Kinematical and dynamical diffraction theories are developed and their application to electron diffraction patterns and contrast effect in transmission electron microscopy are discussed. Special attention is given to metallurgical applications such as plastic deformation, fracture, precipitation, and phase transformations. Prereq: Math 4510-20 or consent of instructor.

5640 Structural Characterization of Polymers (3) (Same as Chem. Engr. 5640.)

5650 Mechanical Behavior of Solid Polymers (3) (Same as Chem. Engr. 5650.)

5750 Corrosion (3) Analysis of corrosion processes in terms of polarization measurements and the Pourbaix diagram. Influence of stress, temperature, and localized conditions contributing to pitting, crevice, and stress corrosion cracking. Prereq: 5650 or consent of instructor.

5810-20-30 Special Topics in Metallurgy (3, 3, 3) Latest developments in the field of solid state physics and metallurgy. Prereq: 6810 or consent of instructor.

6410-20 Thermodynamics of Solids (3, 3) Classical and statistical thermodynamic analysis of the stability of solid solutions, compounds, and complex alloys. Prereq: 5910-20-30 or consent of instructor.

6810 Mechanical and Physical Properties of Crystals I (3) The anisotropic behavior of crystalline materials treated by matrix and tensor techniques. Property classification according to transformation behavior. Prereq: Core curriculum in Met. Engr. and Math. 4500 or 4710 or consent of instructor.

6820 Mechanical and Physical Properties of Crystals II (3) Continuation of Metallurgical Engineering 6810 with emphasis on transport phenomena and irreversible thermodynamics. Prereq: 6810 or consent of instructor.

6830 Seminar in Anisotropic Properties of Crystals (3) Selected topics of current interest in the area of anisotropic behavior of crystalline materials. May be repeated. Prereq: 6810 or 6820, or consent of instructor.

Civil Engineering

MAJORS

Civil Engineering M.E., M.S., Ph.D. Engineering Materials M.E., M.S.

Emeritus Professors:

Professors:

Associate Professors:

Assistant Professors:

Lecturers:

Masters of Science Program

Graduate programs in Civil Engineering and in Environmental Engineering leading to the degree of Master of Science 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 as a candidate for the Master of Science in Civil Engineering.

CIVIL ENGINEERING

The Department of Civil Engineering offers two options for the Master of Science degree in Civil Engineering.

Option I:
- A minimum of 45 quarter hours, including at least nine hours of thesis, is required.

Option II:
- A minimum of 48 quarter hours, including a three-quarter-hour special problem, is required. The special problem will culminate in a written report which must be approved by the student's major professor.

ENVIRONMENTAL ENGINEERING

For a major in Environmental Engineering the Bachelor's degree may be in fields other than Civil Engineering. In some cases prerequisite undergraduate courses may be indicated, and in general these must be completed before courses for graduate credit can be taken.

The Department of Civil Engineering offers both Thesis and Non-Thesis Options for work toward the Master of Science degree in Environmental Engineering.

Option I:
- The student must present a minimum of 45 quarter hours of approved graduate courses. The major shall include a minimum of nine quarter hours of thesis and 18 quarter hours credit of approved Environmental Engineering course work. A minor may be selected but is not necessarily required.

Option II:
- The student must present a minimum of 48 quarter hours of approved graduate courses. The major shall include a minimum of 27 quarter hours of approved Environmental Engineering course work. A minor may be selected but is not necessarily required.

Civil Engineering

4120 Concrete Design (3) Reinforced concrete continuous beams and floor slabs; footings, and retaining walls. Prereq: Concrete Design and Deflections and Statistically Indeterminate Structures.


4230 Legal and Ethical Aspects of Engineering (3) Legal principles underlying engineering work; laws of contracts, torts, agency, real property; problems of professional registration and ethics.

4240 Structural Design (3) Plastic theory, eccentric connections, industrial building design, timber design. Two 3-hr periods. Prereq: Design of Framed Structures and Deflections and Statistically Indeterminate Structures.

4260 Photogrammetry (3) Methods of plotting maps from aerial photographs; stereoscopic plotting instruments; applications. Prereq: Engr. Surveys, or Forestry Summer Camp for forestry majors.

4290 Analysis of Framed Structures (3) Maximum stresses and moving loads; uses of influence lines; lateral forces due to earthquake and wind; analysis of portals, building frames and space frames.

4430 Construction Methods and Equipment (3) Fundamental operations in construction and selection of equipment; production rates, balancing of equipment, and cost estimates.

4510-20 Advanced Structural Design (3, 3) Plastic design in steel in 4510; design of special structures in 4520. Prereq: Design of Framed Structures for 4510; and Concrete Design for 4520.

4530 Cost Comparison in Design and Construction (3) Theoretical and practical aspects of cost comparison in design and construction. The cost comparison of alternate designs with emphasis on applications to civil engineering problems. Prereq: Concrete Design, Design of Framed Structures.

4540 Computer Utilization (3) Computer use, the economic justification, and the extent of its use by industry. The utilization of computers for the solution of civil engineering problems. Prereq: Design of Framed Structures.

4550 Engineering Behavior of Soils (3) Plastic and elastic behavior of soils, determination and use of properties of in-situ soils. Prereq: 5220 or consent of instructor. 2 hrs and 1 lab.

4560 Stabilization of Soils (3) Mechanic stability of soils by compaction, drainage, and blending; chemical stabilization of soils with admixtures; waterproofing and modifying soils and additives. Prereq: Physical Properties of Soils. 2 hrs and 1 lab.

4620 Airport Planning and Design I (3) Emphasis on airport master planning. Included for consideration on the air side; runway configuration, capacity, geometrics and lighting; and on the land side are included terminal layout and design, and ground access systems and parking. Prereq: Airport Planning and Transportation Engineering.

4640 Traffic Engineering (3) Study of the characteristics of the driver, vehicle, and roadway and their interrelationship; traffic studies; basic considerations of traffic circulation and control; elements of urban transportation planning studies.

5460 Airport Planning and Design II (3) Integration of and application of the principles of airport master planning for the purpose of site selection and design of an airport facility through a comprehensive team project, also includes environmental evaluation of design. Prereq: 4620. 1 hr and 2 labs.

4710 Portland Cement Concrete Mix Design (3) Properties and use of portland cement concrete, methods of concrete mix design, nondestructive concrete evaluation testing, use of concrete admixtures. Prereq: Materials of Construction. 2 hrs and 1 lab.

4720 Asphalt and Bituminous Concrete (3) Properties and use of asphalt and asphalts mix design, mix design of bituminous concrete. Emphasis on use of asphalt in transportation construction projects. Prereq: Materials of Construction. 2 hrs and 1 lab.

4850 Elementary Structural Matrix Methods (3) (Same as Engr. Mech. 4850 and Arch. 4850.)

5000 Thesis

5110-20 Statically Indeterminate Structures (3, 3) Deflections of beams and trusses; analysis by force methods and by slope-deflection in 5110; analysis by moment distribution and other displacement methods, secondary stresses in 5120.

5140 Statically Indeterminate Structures (3) Analysis of complex plane and space frames. Prereq: 5110 and 5120.

5150 Matrix Formulation of Structural Problems (3) Review of matrix algebra, vectors, stability considerations; stiffness and flexibility analysis of plane trusses, general members and structures composed of general members. Prereq: 4540 or consent of instructor.

5150 Analysis and Design of Plate Structures (3) Fundamental theories of bending and buckling of plates; practical application of these theories in analysis and design of bridge and building floors and structural plate components. Prereq: 5110.

5170 Introduction to Structural Dynamics (3) Analysis of free and forced vibrations, and transient response of structures having many degrees of freedom; elastic-plastic behavior considered for structural systems; approximate design methods developed. Prereq: 5120, 5150.
5180 Finite Element Structural Analysis (3) Application of the finite element method to structural analysis: plane stress, plane strain, axisymmetric, and three-dimensional elements; use of typical computer programs. Prereq: 5170 and 5150. (Same as Engr. Mech. 5180.)

5220 Pavement Design (3) Characteristics of pavement loads; theory of pavement design; design practices; construction and maintenance. Prereq: Engr. Properties of Soils.

5240 Advanced Properties of Materials: Cement and Concrete (3) Permeability and durability; strength, volume changes, and creep; elastic and thermal properties of concrete, special types of concrete; causes of failure. Prereq: 4710.

5250 Advanced Properties of Materials: Bituminous Substances and Mixes (3) Serviceability concepts; pavement failures and remedies; bituminous pavement maintenance techniques; other uses of asphalt products. Prereq: 4720.

5270 Planning and Transportation (3) Methods for preparation of transportation elements of comprehensive development plans. Analysis of relationships between various transportation modes and between transportation and other community features. (Same as Planning 5270.)

5310 Engineering Practice (3) Valuation and feasibility studies; depreciation and useful life; engineering economics.

5320-30 Engineering Practice Applied to Administration of Engineering Projects (3, 3) Factors of engineering administration; planning of industrial projects; cost estimates and methods of financing.

5420 Structural Model Analysis (3) Experimental methods of shear, moment, and stress analysis.


5560 Soil Mechanics—Elastic Behavior (3) Stress-deformation characteristics, theory of consolidation, theories of settlement analysis. Prereq: Physical Properties of Soils or consent of instructor.

5570 Soil Mechanics—Seepage (3) Saturated flow through embankments, filter design criteria, seepage forces and velocities, subdrains, and ponded embankments. Prereq: Physical Properties of Soils or consent of instructor.

5610 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: Design of Framed Structures.

5730 Prestressed Concrete (3) Properties of prestressing materials and anchorages systems; methods of pre-tensioning and post-tensioning; analysis and design of members and continuous structures.

5740 Behavior of Reinforced Concrete Members (3) Ultimate strength and behavior of re-inforced concrete members: relation between research results and current specifications for design. Prereq: 4120.

5800 Urban Systems: Engineering and Management (3) The management and engineering of urban systems under the responsibility of a city manager and/or city engineer such as streets, lighting, water, sewerage, refuse collection, etc. Prereq: Graduate standing or consent of instructor.

5810 Traffic Engineering-Characteristics (3) Theoretical and practical considerations of the characteristics of the driver-vehicle-roadway system; level-of-service concept of capacity. Coreq: Statistics 3450 or 5311. 2 hrs and one 2-hr lab.

5820 Traffic Engineering-Operations (3) Fixed-time and volume-density controllers; progression systems; one-way operations; reversible flows; system operation, including computerized networks; legal aspects of operational controls. Prereq: 5810. 2 hrs and one 2-hr lab.

5840 Geometric Design (3) Advanced theory and practical implementation of geometric design of highways. Prereq: Highway Engineering (3).

5850 Functional Design of City Streets and Urban Freeways (3) The effect of street systems upon urban growth and development; classification and function of streets; design features, including crossing, intersections, utility considerations, parking, effect of mass transportation; channelization; marketing; lighting; the freeway, frontage road, surface street system. Prereq: Consent of Instructor.

5850 Urban Transportation Planning (3) The use of various models for the prediction of traffic demands and vehicular flows; land use planning; parking needs. Prereq: 5810.

5870 Public Transit Planning (3) The planning and development of public transit systems; market study of present transit system; the needs and uses of public transit in the community's need; user preferences; modal split models; and the total social, political, economic and technical impacts of public transit. Prereq: Highway Engineering I or Graduate Standing.

5900 Special Problems in Civil Engineering (1-9) Study of a civil engineering topic to fulfill the special problem requirement in the non-thesis program. Enrollment limited to civil engineering students in non-thesis program. May be repeated. Maximum 9 hrs. S/NC only. Prereq: Consent of instructor.

6130 Elastic Stability of Skeletal Structures (3) A comprehensive treatment of the elastic instability and failure of individual members, stability functions, triangulated and rigid jointed frames. Prereq: 5110, 5120, 5150. (Same as Engr. Mech. 6130.)

6150 Advanced Matrix Formulation of Structural Problems (3) Analysis of complex structures using space frames containing non-prismatic curved members; finite element methods of analysis; methods of solution utilizing digital computers. Prereq: 5120 and 5150.

6610 Behavior of Steel Bridges and Buildings (3) Behavior, analysis, and design of plate girders, columns and composite members subjected to static and dynamic loading. Prereq: 5710 and 5610.

6610 Behavior of Reinforced Concrete Beams and Frames (3) Ultimate strength and behavior of statically indeterminate reinforced concrete structures; subjected to static and dynamic loading. Prereq: 5710 and 5610.

6740 Behavior of Reinforced Concrete Slabs (3) Behavior of reinforced concrete slabs; finite element solutions; ACI Code methods; yield-line theory. Prereq: 5740, 5160 or EM 6310.

6830 Traffic Flow Theory (3) Special problems in traffic engineering: queueing theory, Markov processes, Monte Carlo methods, and simulations of various conditions and/or designs. Prereq: 4540 or Math. 3150. 5820.

5880 Statewide Passenger Transportation Planning (3) Preparation of comprehensive multi-modal transportation systems II traffic models, functional classification, programming and scheduling. Emphasis on government policy decisions, especially as they affect air and highway investments. Prereq: 5860.

5870 Future Transit Technology and Research (3) New transit systems and new technology are identified and evaluated. Also considered are the role of public transit in public transit in possible research areas in both technology and planning process and possible research designs. Prereq: 5870.

5880 Planning Models for Transportation Systems (3) An analytical analysis of trip generation employing mathematical, economic, and computer science techniques. Also an introduction to modal split, trip distribution, and trip assignment will be made. These statistical models are integrated into the urban transportation planning process. State-of-the-art and new modeling techniques are investigated. Prereq: 5860 or 5870, Math 3150 and Stat. 3450.

5900 Planning Models for Transportation Systems (3) An analytical analysis of modal split, trip distribution, and trip assignment. Mathematical, statistical, and computer science techniques are used in the modeling process. These models are integrated for use in the urban transportation planning process. Prereq: 5880.

6910-20-30 Special Topics in Civil Engineering (3, 3, 3) Selected advanced problems of current interest in Civil Engineering. Prereq: Consent of Instructor.

NOTE: Not all of the above courses will be offered in any one year.

Environmental Engineering

3000 Introduction to Environmental Engineering (3) Introduction to man's interaction with the air, water, and land environment in which he lives; role of engineering in environmental control.

4000 Unit Operations of Environmental Pollution Control (3) Physical unit operations and chemical unit processes employed in air, land, and water pollution control activities. Theoretical development of design models and evaluation of process performance. Topics include mixing, sedimentation, filtration, mass transfer, and adsorption. Prereq: 3000.


4150 Urban Water Management (3) Introduction to urban water modeling; evaluation of optimum urban water policies; formulation of system constraints and analysis of decision-making process; management of surface and ground water for beneficial use. Prereq: 3000 and Elementary Hydrology.

4210 Water Resources Engineering Design (3) Elements of water resource structures and systems, including reservoirs, dams, control works, and open channel design. Dam safety and control, environmental impact of reservoir projects. Prereq: Consent of Instructor.

4420 Water Resources Engineering Development (3) Water resource management of single and/or multiple purpose projects, due development and management of single or multipurpose planning; economics in alternative decisions; principal water uses; multiobjective evaluation procedures for water and resource projects; Tennessee water laws; special topics of current interest. Prereq: Consent of instructor.

4330 Hydrologic Design (3) Application of frequency and regression analysis to hydro-
logic design of water resources system; unsteady surface runoff and streamflow modeling; urban peak runoff design using kinematic wave theory; evaluation of effects of land use changes on streamflow quantity and quality. Prereq: Elementary Hydrology.

4500 Water Quality Management (3) Water quality control objectives, methods, and philosophies; water quality criteria; effect of various uses of water quality; receiving water characteristics and waste assimilation capacity; regulatory standards; economic considerations. Prereq: Introduction to Environmental Engineering.

4510 Elements of Water and Wastewater Transport Systems (3) An introduction to theory and design of water transportation and distribution systems and wastewater collection systems. Prereq: Introduction to Environmental Engineering.

4520 Elements of Water and Wastewater Treatment Systems Design (3) An introduction to the unit operations employed in the design of water and wastewater treatment plants. Prereq: 4000.

4530 Sanitary Engineering Laboratory (3) Physical, chemical, and bacteriological analysis of water and wastewater. Prereq: 4500. 3 labs.

4600 Solid Waste Management (3) Quantities and characteristics of solid wastes; collection methods and equipment; disposal and recycle techniques; economics; planning and management. Prereq: 3000.

4700 Air Pollution-Air Resources Management (3) An introductory course on the concepts of air pollution; analysis of the relationship among emission rates, atmospheric characteristics and topographic factors, and adverse effects on receptors; engineering approaches for air pollution control.

4810 Water Law (3) Survey study in water law, including case studies and water law doctrines. (Same as Water Res. Development 4810.)

5000 Thesis


5160 Planning and Utilities (3) Planning for adequate water supply and sewage waste disposal in the urban area. Emphasis on area development, and the problems of utility service policies. Not for Civil Engineering majors. (Same as Planning.

5200 Water Resources Systems (3) Control, utilization and management of water in water resources engineering. (Same as Water Res. Development 5200.)

5210 Advanced Water Resources Engineering (3) Complex problems encountered in water resources engineering such as water hammer, surges, wave action, unsteady motion, etc. Analysis of such problems preliminary to design of complex water resources structures.


5232 Sediment Transportation (3) Sediment properties and their measurements; bed loads and suspended load movement; erosion, scour, transport and deposition of sediments by flowing water; settling of reservoirs and related topics. Prereq: 5230.

5234 Flood Damage Reduction (3) Survey of national, regional, local flood problems; hydrologic design of flood control measures; land-use controls and adjustments; floodproofing, flood insurance, and other flood damage reduction techniques. An interdisciplinary approach in floodplain management; case studies. Prereq: Consent of instructor.

5241 Basic Principles of Remote Sensing (3) Introduction to the applications of remote sensing in agriculture, engineering, forestry, meteorology, land use planning, and resource management; properties of electromagnetic radiation including wave theory, physical and geometrical optics, properties of remote sensors, of radiation and matter; current data handling technology. Prereq: Consent of instructor.

5262 Remote Sensing Data Acquisition (3) Theory of active and passive sensors, their areas of specialization, description of remote sensing platforms, including the Earth Resources Satellite Communications System; mission planning. Prereq: 5260 or consent of instructor.

5260 Remote Sensing Data Analysis and Interpretation (3) Modern and automatic methods of data analysis and interpretation, formatting and display, pattern recognition techniques; use of automated data processing equipment for data storage, retrieval, analysis and classification. Prereq: 5260; Math 3150, Stat 3450.

5301 Advanced Hydrologic Analysis I (3) Interpretation of hydrologic data using methods of systems analysis. Hydrologic components are analyzed as linear and non-linear systems and integrated into mathematical models of watershed response. Methods are presented for optimizing model parameters with illustrative examples. Prereq: Consent of instructor.

5302 Advanced Hydrologic Analysis II (3) Continuous streamflow records are interpreted using methods of stochastic hydrologic theory, including flow frequency analysis. Hydrologic design of water resources systems using streamflow simulation techniques including autoregressive and Gaussian noise models. Prereq: Consent of Instructor.

5310 Groundwater Transport Processes (3) Dynamics of flow in porous media with emphasis on physical processes important in subsurface hydrology. Hydrodynamic dispersion, anisotropy, layered soils, and unsaturated flow phenomena. Analytical solutions of flow equations, Dupuit approximation, analogous and numerical methods, and numerical solutions. Prereq: Fluid Mechanics or consent of instructor.

5311 Groundwater Flow (3) Water well design, quantitative evaluation of aquifers; artificial recharge; surcharge protection; design of groundwater investigations. Prereq: 5310.

5330 Descriptive Hydrology (3) Occurrence and description of elements of the hydrologic cycle, its effects on earth and its relation to man. Not for Civil Engineering majors. (Same as Water Res. Development 5330.)

5501 Water and Wastewater Treatment Theory I (3) Theory of unit operations employed in sanitary engineering. Prereq: 4520.

5502 Water and Wastewater Treatment Theory II (3) Theory of physical, chemical, and biological processes employed in sanitary engineering. Prereq: 5501.


5543 Industrial Wastes (3) Sources, characteristics, treatment, and plant design. Prereq: 5502.

5561 Aquatic Environment Pollution (3) A study of the effects resulting from agricultural, municipal, and industrial pollution upon the physical, chemical, and biological characteristics of natural waters. Prereq: 4500.

5582 Microbiology for Sanitary Engineers (3) A study of microorganisms and microbiological processes which are significant in sanitary engineering, including bacterial population, identification, enzymes, metabolic reactions, energy transfer, synthesis and growth; aerobic and anerobic biological treatment processes. Prereq: Graduate standing.

5793 Advanced Sanitary Engineering Laboratory (3) Advanced laboratory techniques used in the analysis of water and wastewater. Application of modern instrumental procedures for chemical, biological, and analytical analysis. Prereq: 4530. 3 labs.


5700 Planning and Air Pollution Control (3) The relationship between air pollution, area development, and urban growth. Social, economic, and political processes involved in air pollution control.

5710 Air Pollution Control Engineering (3) Emission control systems for industrial and power generating processes, stack sampling methods, and control methods and equipment. Prereq: 4700 and Fluid Mechanics.

5720 Air Pollution Particle Collection Theory (3) The mechanics of particles suspended in a gaseous medium including particle motion, collision, coagulation, and aerodynamic capture of particles. Prereq: 4700 and Fluid Mechanics.

5730 Air Pollution Control Device Design (3) Design and evaluation of systems used to control the emission of gaseous and particle air pollutants. Components include types of specific devices and systems. Prereq: 5720.

5740 Dynamical and Physical Meteorology (3) Fundamental physical principles of the atmospheric sciences are developed. Specific topics include atmospheric energetics, general circulation, perturbation theory, vorticity theory, the equation of motion, solar and terrestrial radiation, and the thermodynamics of dry and moist air. Prereq: Math 4550 and Fluid Mechanics or equivalent.

5750 Turbulence in the Atmosphere (3) Present state of our knowledge of turbulence in the atmosphere. Theoretical boundary layer mean wind and temperature profile data are reviewed and related to observations. Methods of estimating surface fluxes, energy spectra, and cumulatronics are outlined. How the theories can be applied to describe changes in turbulence in air flow over urban areas. Mechanisms of formation of clear air turbulence in shear zones in the free atmosphere are suggested. Prereq: 5740.

5760 Diffusion in the Atmosphere (3) Movement and dilution of natural or man-made material released into the atmosphere. Basic theory is developed and observations reviewed.
Specific topics include the rise of buoyant plumes, the relation between Eulerian and Lagrangian spectra, the differences between instantaneous and continuous sources, diffusion in a zone of wind shear and diffusion from urban area sources. Prereq: 5740.

5900 Special Problems in Environmental Engineering
1-2 An analysis and solution of environmental engineering problems to fulfill the special problem requirement in the non-thesis program. Enrollment limited to graduate-level environmental engineering students in the non-thesis program. Prereq: Consent of instructor. May be repeated. Max. 9 hrs. S/NC only.

5910-20 Special Topics (3, 3, 3) Problems and topics related to current developments in the field of environmental engineering not included in other courses.

5990 Environmental Engineering Seminar (1) Discussions on all phases of environmental engineering including reports on current research at The University of Tennessee, Knoxville. Course credit not applicable to graduate degree program. Prereq: Active graduate standing in environmental engineering. May be repeated. Max. 9 hrs. S/NC only.

6110-20 Advanced Topics in Fluid Mechanics and Convective Transfer (3, 3) (Same as Engr. Mechanics 6110-20.)


6910-20-30 Special Topics in Environmental Engineering (3, 3, 3) Selected advanced problems of current interest in environmental engineering. Prereq: Consent of instructor.

Note: Not all of the above graduate courses will be offered in any one year. Prerequisites to all graduate courses: Consent of instructor.

**Electrical Engineering**

**MAJOR DEGREES**

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

**Professors:**


**Assistant Professors:**

T. W. Reddoch, Ph.D. Louisiana State; W. Waller, Ph.D. Tennessee.

**MASTER OF SCIENCE PROGRAM**

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

Specific departmental requirements include:

1. Electrical Engineering 5070-80 and 5090 or 5100.
2. Nine quarter hours of graduate credit in mathematics consisting of Mathematics 4710, 4550, and 4250, or 4510-20-30. Other approved 4000-5000 level mathematics courses must be substituted for any of the above course material covered in undergraduate work.
3. An additional 18 quarter hours of 5000-level work in Electrical Engineering or nine quarter hours of 5000-level work in Environmental Engineering and nine quarter hours of another approved area.
4. Master's thesis, totaling nine quarter hours or more.
5. A final oral examination covering the thesis and related course work.

**DOCTORAL PROGRAM**

The Ph.D. degree with a major in Electrical Engineering may be pursued in the areas of circuit theory, computers, quantum electronics, electromagnetic theory, plasma engineering, power systems, solid-state electronics, and control systems.

Specific departmental requirements for the Ph.D. degree include the following:

1. A minimum of 72 quarter hours of course work excluding thesis, research, and dissertation credit.
2. A minimum of 36 quarter hours credit in doctoral dissertation.
3. 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.
4. Satisfactory performance on both a written and an oral preliminary examination.
5. Participation in departmental seminars.

The 72 quarter hours of course work must satisfy the following requirements:

- A minimum of 36 quarter hours of work in electrical engineering at the 5000- and 6000-levels.
- A minimum of 12 quarter hours of 6000-level course work. At least three quarter hours must be in an area other than the student's major area.
- A minimum of 18 hours of mathematics at the 4000-level or above. Mathematics (or Physics) 5610-20-30 is usually required.

Courses required in the electrical engineering undergraduate curriculum cannot be used in either the M.S. or Ph.D. programs. In addition, 4000-level courses in electrical engineering may not be used if 5000-level courses are available in the same area.

Many of the electrical engineering courses are offered in the evening. Engineers working in industry are encouraged to participate in the department's graduate program.

Departmental graduate programs providing special opportunities for academic and research work in areas pertinent to atmospheric and space flight are also available at the Space Institute, Tullahoma.


3050 Basic Field Theory (3) Forces between charges, electric and magnetic fields, Gauss' law and divergence, potential and line integrals, material bodies, polarization, magnetic circuits, Maxwell's equations, dynamic potentials. Prereq: Multivariable calculus and linear algebra.

3080 Energy Conversion (3) Magnetic circuits, transformer theory and operation, principles of electromechanical energy conversion with emphasis on input-output characteristics; steady-state analysis of induction motors and d.c. machines. Prereq: 3040. 4 labs.

3090 Energy System Operation (3) Synchronous machines, transmission-lines, and transformers as power system elements; power system representations, per unit calculation, symmetrical components, and fault studies. Prereq: 3080. 4 labs.


3110 Basic Electrical Engineering-Circuits and Fields (3) For non-electrical engineering majors. Prereq. 3110. 4 labs.

3120 Basic Electrical Engineering-Electronics (3) For non-electrical engineering majors. Prereq. 3110. 4 labs.

3130 Basic Electrical Engineering-Machinery (3) For non-electrical engineering majors. Prereq. 3110. 4 labs.

3150 Basic Control Systems (3) Systems differential equations; solution by classical methods; Laplace transform method; design of control and computer systems. For non-electricals only. Prereq. 3120, Math 4610.

3180 Logic Design of Digital Systems (3) Introduction to boolean algebra and design
of combinational circuits. Presents gate and flip-flop logic, design of clocked sequential circuits and other systems containing memory. Introduction to minicomputer architecture and system components. Includes basic concepts of microprocessor, number systems, functions of Arithmetic, Storage, Input/Output, and Control Systems. Instruction set capabilities and machine language programming. Prereq: 3010, Computer Science 3150, 4 labs.

3190 Plasma I (3) Engineering applications of physical electronics, plasma effects and devices. Topics include electrostatic precipitators and plasma devices. Course work is devoted to operation and applications (electro-optics), and MHD, controlled thermonuclear and other techniques of advanced power production. Prereq: Fundamentals of Physics: Electricity, Waves and Optics, Modern Physics. 4 labs.

3720 Linear Systems Analysis (3) Review of steady-state and transient response; log-frequency, gain-phase, and polar plots; block diagram transformation; signal flow graphs; analogous systems; properties of second order systems; introduction to feedback theory; stability criteria. Prereq: 3010 and Math 3150. Occasional labs. Coreq: 3180.

3810 Electronics I—Basic Electronic Processes (3) Current conduction in semiconductors and high vacuum; theory of p-n junctions, characteristics of diodes; rectifiers and diode switches. Prereq: Circuits III, 3040 concurrently. 4 labs.

3820 Electronics II—Basic Electronic Devices (3) Characteristics and equivalent circuits of vacuum tubes and transistors with application to amplifier and control circuits. Prereq: 3810. 4 labs.


4020 Direct Electrical Energy Conversion (3) Basic principles, devices and applications of ac and dc energy conversion. Prereq: Fundamentals of Physics: Electricity, Waves and Optics, Modern Physics. 3050, 3190, 3810, and ME 3530.

4080 Microwave Circuits and Electronics (3) Circuits represented by wave shattering, isolators, gyrators, couplers, microwave vacuum diodes. Design of microwave field devices, parametric amplifiers, power generator semiconductors, varactor semiconductors. Prereq: 3060. 4 labs.

4090 Propagation II (3) The space and guided wave propagation. Obliquely incident waves, conducting waveguides, short wire radiators, tropospheric and ionospheric propagation, f and spherical earth propagation multipath waves. Prereq: 3060. 4 labs.


4200 Electromagnetic Field Transients (3) Pulse propagation on lines, reflection of waves, traveling and standing waves. Vector representation of pulses from antennas. Prereq: 3060. 4 labs.

4340 Two-Port Networks (3) Two-port parameters. Passivity, activity, and reciprocity, image parameters. Traditional filter theory; frequency transformation techniques; modern filter theory. Maximally flat and equiripple approximations to the ideal filter and the ideal delay. 4 labs.

4350 Elements of Network Synthesis (3) Elements of network synthesis. Introduction to network design using frequency domain techniques. Applications to cascaded two-port networks. Prereq: 3010, 3180, 3810 and ME 3530. 4 labs.


4400 Introduction to State Variable Methods (3) Analysis of continuous and discrete systems in the time domain including both manual and computer-aided methods; computer-aided design of circuits and systems. Prereq: 3720.

4410 Power System Components and Control (3) Analysis of power system components and their interconnection. Studies in control of power and frequency as well as voltage and reactive power. Prereq: 3010.

4420 Power Systems Analysis (3) System studies including load flow, faults, and stability. Prereq: 3060.

4430 Transmission, Distribution, and Protection (3) Studies in underground and d.c. transmission systems. Power system protection with emphasis on over-voltages and insulation requirements; system protection against faults. Prereq: 3090.

4460 Lasers and Masers (3) Introduction to the principles of laser and maser operation based on classical concepts and electrical-engineering analogies. Consideration of practical devices and applications.

4500 Electro-Optic Detection and Instrumentation (3) Sensitivity, resolution (frequency response) and noise concepts of and practical considerations for monolithic and hybrid laser systems. The laser is a significant component of optical systems. Prereq: 3190.


4520 Electro-Optic Detection and Instrumentation (3) Sensitivity, resolution (frequency response) and noise concepts of and practical applications in the field of optical recording. The laser is a significant component of optical systems. Prereq: 3190.

4570 Electro-Acoustics (3) Reproduction of monophonic and stereophonic sound, microphonics, sound recording, magnetic recording, film recording; acoustics of studios, auditoriums.

4600 Bioelectric Instrumentation (3) Principles and mechanisms of the electric and magnetic fields produced by the body and the methods for measuring them. Applications to the study of the nervous system. 4 labs.

4620 Sequential Machine and Digital System Design (3) Mathematical formulation of control system design. Introduction to root-locus design, optimal gain adjustments, compensation networks, and digital control system design. Prereq: 3720. 4 labs.

4630 Digital System Organization and Design (3) Consider system organization of digital systems, including computer components, data processing computers, computer-aided design techniques, and computer architectures and comparisons. Characteristics of computer system structures, storage devices, and computer-aided design techniques. Prereq: 3180. 4 labs.

4660 Electronic Power Amplifiers (3) Traveling amplifier design, amplifier requirements, recording systems, and noise problems.

4680 Electronic Power Amplifiers (3) Traveling amplifier design, amplifier requirements, recording systems, and noise problems.
Role of pattern recognition within the framework of artificial intelligence. Principal topics considered: pattern learning and adaptive machines. Typical applications of pattern recognition to problems of practical significance. Computer simulation and elementary pattern recognition problems. Prereq: 3100, Elementary Linear Algebra, Calculus of Several Variables and Infinite Series and Math 3150, or consent of instructor.

4830 Image Processing by Computer (3) Principal methods for coding, storing, and processing images by means of digital computers. Computational algorithms for image operations. Prereq: 3100, or consent of instructor.

4850 Small Computer Systems (3) Basic structure of small computer systems, input-output techniques, interrupt structures, peripheral devices, system software and assembly language programming. Course is project-oriented. Prereq: Engineering Computations, Computer Science 3150 or equivalent or consent of instructor. (Same as Computer Science 4560.)

4910-20-30 Special Electrical Engineering Problems (3, 3, 3) Problems in electrical engineering involving library or laboratory research.

5000 Thesis

5040-50-60 Electrical Engineering Research (3, 3, 3)

5070-80 Modern Transform Methods (3, 3) Laplace transform and complex variable theory, Z-transform, difference equations and distributed parameter systems. Coreq: Math 4510 or 4540.


5160 Introduction to Quantum Electronic Devices (3) Quantum mechanical devices. Applications of quantum mechanics to the study of solid state devices. Quantum mechanical effects in photodetectors, photomultipliers, and solid state light sources. Prereq: 4100 or consent of instructor.

5170 Bioengineering Systems I Models, Systems Analysis and Simulation (3) Modeling techniques applied to physiological systems. System properties of resistance, impedance, and storage are investigated. Analogy and digital simulation of biological systems. Prereq: 3100 or consent of instructor.

5180 Bioengineering Systems II Bioelectric Phenomena (3) A study of the electrical phenomena associated with biological systems both as stimuli and responses. Quantitative studies in cardiovascular, respiratory, immune, and storage are investigated. Analogy and digital simulation of biological systems. Prereq: 3100 or consent of instructor.

5190 Bioengineering Systems III Instrumentation and Analysis (3) An investigation of the process by which information is gathered and transmitted from a biological system under test. Subjects include the biophysical properties of the system under test, and the methods for the analysis and modeling, in order to maximize the yield of meaningful information from the physiological system. Prereq: 4650 or consent of instructor.

5210-20 Advanced Electrical Machinery (3, 3) Fundamental processes of electromechanical energy conversion; application in conventional devices. Stability analysis of rotating machinery. Park's transformation and the two-axis model, with emphasis on the transient behaviour of isolated and interconnected rotating machines. Prereq: Consent of instructor.

5230 Advanced Electrical Machinery Applications (3) Linear motors; pole amplitude modulation and other speed control techniques; variable frequency operation. Prereq: 5210.

5240-50 Linear Control System Theory (3, 3) Mathematical theory of feedback; analysis and design of linear control systems using frequency response and root-locus techniques; stability criteria; state-space representation; pole-zero synthesis; multivariable systems; characteristics of typical control elements. Sampled-data as well as continuous-data systems are studied. Coreq: 5070-80.

5260 Nonlinear System Theory (3) Analysis and design of nonlinear feedback control systems including: construction of linear models; describing function and phase techniques; methods of analysis and design of feedback loops, operability, and stability analysis; introduction to Liapunov's direct method. Prereq: 5240.


5370 Advanced Direct Electrical Energy Conversion I (3) Theory, latest devices and applications for production of electrical energy by the direct conversion of mechanical and photoelectric effects. Prereq: 4020 or ME 4150 or equivalent, or consent of instructor.

5380 Advanced Direct Electrical Energy Conversion II (3) Theory, latest devices and engineering applications for production of electrical energy by the gaseous means of thermionic, magnetohydrodynamic, and electrogasdynamic devices. Prereq: 5370 or equivalent, or consent of instructor.

5390 Advanced Direct Electrical Energy Conversion III (3) Prereq: 5370 and 5380, or equivalent.

5410 Power System Networks (3) Sequence impedances for transmission lines, machines, and transmission. Application of system network characteristics such as $Z_{bus}$, $Y_{bus}$, and others. Computer methods are emphasized. Graduate standing or consent of instructor.

5420 Fault and Load Flow Studies (3) Analysis of a power system under both shunt and series fault conditions. Computer methods for fault studies are included. The load flow problem is formulated with computer-aided emphasized. Prereq: 5410 or consent of instructor.

5430 Power System Stability and Control (3) Analysis of power systems for both steady-state and transient stability. Computer methods are emphasized. Graduate standing or consent of instructor. Prereq: 5420.

5440 Distribution Systems (3) Electric power distribution with particular reference to utility systems. Course includes power system growth and planning, operations and regulation. Prereq: 4410, 4420, 4430 or equivalent.

5460 Selected Topics in Power Systems (3) Courses will be offered to meet special needs of students. Possible topics: (1) power system reliability, (2) interconnected system theory, (3) power plant operation, (4) electrical power transmission and distribution, (5) power system relaying. Prereq: Consent of instructor. May be repeated with consent of department.

5510-20-30 Linear Active Circuits (3, 3, 3) Analysis and design of active RLC circuits. Signal processing and amplification, transformers, and operational amplifiers. Coreq: Math 4510 or 4540.

5570-80-90 Electronic Switching Circuits (3, 3, 3) Switching circuits using active devices; includes clipping circuits, clamping circuits, combining circuits, differential and operational amplifiers, and a detailed treatment of feedback amplifiers. Prereq: 3100. Coreq: Math 4510 or 4710.


5625 Introduction to Switching Theory (3) Number system and codes; error detection and correction; features of computer-aided structures; switching algebra; functional blocks. For non-engineering majors only. Prereq: Introduction to Differential Equations and
5535 Introduction to Digital Computer Design (3) General organization of digital data processors; control; operational memory unit; arithmetic unit; control unit; input-output. For non-engineering majors only. Prereq: 4625. 4 labs.

5640-60 Electronic Communication Systems (3, 3) Theory of information transmission in communications systems; mathematical treatment of modulation and demodulation in analog and digital systems; bandwidth requirements, noise, system performance in noise. All modern systems are considered and compared with emphasis on digital data systems. Prereq: Math 3510. 5 Cork: 5820.

5670-80 Introduction to Pattern Recognition (3, 3) (Same as Computer Science 5640-50.)

5620-50 Introduction to Artificial Intelligence (3) (Same as Computer Science 5620.)

5710 Random Process Theory for Engineers (3) Probability and random variables as approaches by set theory. Statistical averages and transformations; Markov, random processes, stationarity correlation functions and temporal analysis, power spectrum and spectral analysis as applied to response of systems to random signals.


5840 Aperture Antennas (3) Huygens principle. Structures, logarithmically periodic antennas. forbidden regions, radiation from periodic structures, coupled modes, propagation in periodic structures. Measurements, display and measurement devices. Prereq: 5810 or equivalent or consent of the instructor. Coreq: Math 4510 or 4710.

5850 Microwave Electronics (3) Space charge waves on electron beams, coupling between beams and waveguide, Klystrons, magnetrons, traveling wave amplifiers and backward wave oscillators. Prereq: 5820.

5860 Electromagnetic Wave Propagation (3) Supplementary studies in wave propagation in isotropic and anisotropic media, transmission lines, plasma, stored energies, propagating and non-propagating modes, orthogonality properties, boundary conditions, radiation conditions, sources. Prereq: 5820.

5870 Introductory Microwave Networks (3) Circuit equivalents for n-port, junctions, obstacles, loading and fillings. One way and two way devices, hybrid directional devices, parameter measurements, reflection charts. Prereq: 5810. Coreq: 5820.

5940-50 Advanced Small Computer Systems (3, 3) Real-time applications, memory and CPU organization, interface software, and peripheral devices. Control and monitoring systems studied. Prereq: 4850 or equivalent or consent of the instructor. Coreq: Math 5940-50.

6000 Doctoral Research and Dissertation

6240 Advanced Systems Theory (3) Advanced analytical methods for systems with deterministic inputs; treatment of discrete-data, non-stationary, and linear systems. Prereq: 5700-80 or equivalent.


6260 Modern Control System Design (3) Design of optimum control systems via variational calculus, maximum principles, dynamic programming, and gradient methods. Prereq: 5240-50 or equivalent.

6270-80-90 Special Topics in Control Systems Theory (3, 3, 3) Advanced problems of current interest to control system engineers. Discussion of new developments as found in current literature. Prereq: 5240-50 and consent of instructor.


650-10 Electrical Conduction in Gases and Plasma Physics (3, 3) (Same as Physics 6500-10.)


6640 Propagation in Periodic Structures (3) Coupled modes, propagation in periodic structures, the k-beta diagram and bounded and forbidden regions, radiation from periodic structures, lumped circuit equivalent antennas. Prereq: 5810-20 and Math 4250, 4550.


6660 Electromagnetic Diffraction and Scattering (3) Diffraction of electromagnetic waves by perfectly conductive and dielectric objects, the Born approximation propagation problem, introduction to modern approximate methods, creeping waves. Prereq: 5810-20 and Math 4250 and 4550.


6760 Coding Theory (3) Presentation of the mathematical structure of algebraic and probabilistic codes. Included are coding metrics and bounds, linear codes, linear feedback shift registers, cyclic codes, burst-error-correcting codes and decoding methods. Prereq: 5090 or consent of instructor.


Note: All of these courses will not be offered during any one year.

Engineering Science and Mechanics

MAJOR: DEGREES

Engineering Science

M.S., Ph.D.

Professors:

W. T. Snyder (Head), Ph.D. Northwestern; C. W. Lee, Ph.D. Illinois Institute of Technology; F. N. Priebe, Ph.D. Tennessee, P.E.; H. Pih, Ph.D. Illinois Institute of Technology; C. D. Scott, Ph.D. Tennessee; L. R. Shope, M.S. Kansas State, P.E.; D. G. Thomas, Ph.D. Ohio State, P.E.

Associate Professors:


Graduate programs leading to the degrees of Master of Science and Doctor of Philosophy with a major in Engineering Science are available to graduates of recognized curricula in engineering, mathematics, or one of the physical or biological sciences. Program options in-
include solid mechanics, fluid mechanics, biomedical engineering, and other engineering sciences. In the biomedical and engineering science option, interdisciplinary programs are arranged to meet individual needs or interests. Each applicant will be advised as to any prerequisite courses before entering a program; the student's program of study must be approved by his or her advisory committee, and must comply with the requirements of the Graduate School. The student's major professor may be selected from a department other than the Department of Engineering Science and Mechanics.

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

THE MASTER'S PROGRAM

Two M.S. plans are offered: Plan I requires a thesis, while Plan II does not. The second plan is offered to meet the needs of engineers employed in industry, or those who plan to teach in community colleges and technical institutes. It will be available, however, to any student who, in the opinion of his or her advisory committee, can benefit from additional course work more than from work on a thesis.

In Plan I a minimum of 45 quarter hours, including the thesis, is required. Plan II a minimum of 48 quarter hours is required. The requirements include the following:

<table>
<thead>
<tr>
<th>Hours Credit</th>
<th>Plan I</th>
<th>Plan II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Engineering Courses (Major option; may include but is not restricted to courses offered by the Engineering Science and Mechanics Department.)</td>
<td>18</td>
<td>27*</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>9</td>
<td>12</td>
</tr>
<tr>
<td>Thesis *Engineering courses under Plan II may include advanced laboratory work or special problem work, for example E.S. &amp; M. 5910 or analogous courses in other departments. A final examination is required under both plans, covering graduate course work and the thesis (if any).</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

THE DOCTORAL PROGRAM

General policies and requirements of the Graduate School relating to admission, residence, languages, research, examinations, faculty advisory committee, and admission to candidacy apply to this program.

Specific departmental requirements for the Ph.D. degree include:

1. A minimum of 108 quarter hours credit beyond the degree exclusive of credit for the Master's thesis. These shall include a minimum of 36 quarter hours credit in Doctoral Research and Dissertation and a minimum of 72 quarter hours credit in other courses.

2. A minimum of 36 quarter hours in engineering graduate courses, exclusive of thesis and dissertation credit. These courses will normally be numbered 5000 and above, with at least 12 quarter hours of 6000-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 or her advisory committee.

3. A minimum of 18 quarter hours in mathematics or computer science in courses numbered 4000 and above, exclusive of a first course in ordinary differential equations.

4. A minimum of nine quarter hours of courses numbered 5000 and above, offered in departments other than Mathematics, Computer Science, and the student's major department and which are not included in the areas of concentration covered under item 2.

5. Active participation in graduate seminars and colloquia.

6. Preliminary Examination consisting of a written qualifying examination and an advanced examination. The qualifying examination covers areas of engineering science and mathematics, for the most part at a level and scope expected of well-qualified students of a Bachelor's degree in engineering. The advanced examination requires demonstration of special competence in the areas of concentration selected by each student under item 2.

7. Submission of a written proposal for dissertation research to the student's advisory committee. Oral defense of the proposal is normally required when the student takes the advanced portion of the preliminary examination.

8. Submission of a dissertation which meets the requirements of the Graduate School, the department, and the student's advisory committee.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>3311</td>
<td>Mechanics of Materials (4) Concepts of stress and strain; stress-strain relations and Mohr's circle; static analysis of members: area moment of inertia; stress and displacement analysis of axially-loaded members; torsion; bending. Not for departmental graduate credit. Prereq: Basic Mechanics I. Coreq: Math-Multi-Variable Calculus and Linear Algebra.</td>
<td>9</td>
</tr>
<tr>
<td>3409</td>
<td>Introduction to Biomedical Engineering (4) Designed to introduce the facets and opportunities of Biomedical Engineering and to provide basic terminology and background knowledge for further courses in the field. Subjects include anatomy, microbiology, bio-materials, mathematical models of body systems, etc. Coreq: Multivariable calculus and linear algebra or consent of instructor.</td>
<td>9</td>
</tr>
</tbody>
</table>

3420 Introduction to Clinical Engineering (3) Designed to train students in life sciences, health professions, and in the use and applications of medical instruments. Body systems are introduced, and instruments used in control of those systems are explained and demonstrated. Prereq: 3410 or consent of instructor.

3430 Perspectives on Medical Ceramics (3) Details development of implant material from both an engineering and a medical viewpoint. Demonstrates results of combined efforts of physician and biomedical engineer. Audio-visual aids and models are used to reinforce lecture topics. Prereq: 3410 and Engineering Materials I.

3439 Medical Ceramics Laboratory (1) Surgical and observations and laboratory experiments to illustrate design and application parameters. Design project or paper required. Coreq: 3430.

3520 Materials Behavior and Chemical Process Equipment Design (3) (Same as Metalurgical Engineering 3520).

3700 Dynamics (4) Kinematics of rigid bodies; mass moments of inertia; coulomb friction; kinematics of rigid bodies with varying mass; kinematics of rotating coordinate systems; LaGrange's equations. Prereq: Dynamics and 2nd quarter Linear Algebra and Calculus of Several Variables.

3710 Intermediate Dynamics (3) Introduction to three dimensional dynamics of particles and rigid bodies; dynamics of bodies with varying mass; kinematics of rotating coordinate systems; LaGrange's equations will be demonstrated. Course identifies new and critical role for biomedical engineering in health care systems, and includes analysis of hospital and clinical systems. Prereq: 3410 or consent of instructor.

4420 Engineering Aspects of Infection Control (3) Biomedical engineer's role in infection control will be related to hospital and clinical activities. Fluid flow phenomenon, pressure measurement methods, and basic bacteriological and mycological tests will be demonstrated. Course identifies new and critical role for biomedical engineering in health care systems, and includes analysis of hospital and clinical systems. Prereq: 3410 or consent of instructor.

4430 Orthopaedic Biomechanics (3) Introduction to engineering principles and applications in orthopaedics and rehabilitation. Topics include statics, Newton's laws of motion, stiffness in simple beam sections, engineering materials, and biological materials. Prereq: Consent of instructor.

4500 Applied Mechanics for Life Scientists (4) Concise and broad coverage of basic principles and concepts of mechanics. Fundamental concepts, statics, vibrations, continuum mechanics and properties of materials. Applications in engineering and medicine. Prereq: Analytic Geometry and Calculus of a Single Variable or consent of instructor.

4520 Biomedical Fluid Mechanics (3) Discuss objectives, review foundations and present developments in biomedical fluid mechanics. Properties of human blood and blood vessels, flow characteristics in arterial and systemic circulation. Topics include motion of blood and flow characteristics in biological systems. Project and/or term paper required. Coreq: 4520.

4529 Biomedical Fluid Mechanics Laboratory (2) Measurements of blood flow characteristics in biological systems. Project and/or term paper required. Coreq: 4520.

4530 Biomechanics (3) Discuss objectives, review foundations and present developments in areas of mechanical properties of living tis-
sues, biomechanics of injury and prosthesis, material compatibility of prosthetic devices and biomechanical problems related to impact. Prereq: 4500 or consent of instructor.

4540 Fracture-Safe Design (3) A critical review of mechanical properties of materials that are indicated for material substitution; introduction to stress-strain diagrams; theory and techniques of the brittle coating method; introduction to other stress analysis methods. Prereq: Mechanics of Materials, Circuits II, or Basic Electrical Engineering-Circuits and Fields. 2 hrs and a 3-hr lab.

4610 Experimental Stress Analysis (3) Instrumentation of measuring systems for dynamic events and responses; signal conditioning; oscillographs, oscilloscopes, and magnetic tape recording; telemetry and data transmission; data processing. Prereq: Dynamics, Mechanics of Materials, and Fundamentals of Physics: Electricity, Waves, and Optics, Modern Physics. 2 hrs and a 3-hr lab.

4620 Dynamic Data Acquisition (3) Instrumentation of measuring systems for dynamic events and responses; signal conditioning; oscillographs, oscilloscopes, and magnetic tape recording; telemetry and data transmission; data processing. Prereq: Dynamics, Mechanics of Materials, and Fundamentals of Physics: Electricity, Waves, and Optics, Modern Physics. 2 hrs and a 3-hr lab.

4630 Introductory Photomechanics (3) Introduction to photoelasticity, photoelastic coating method, holographic interferometry, and techniques of the brittle coating method; introduction to stress-strain diagrams; theory and techniques of the brittle coating method; introduction to other stress analysis methods. Prereq: Mechanics of Materials, Circuits II, or Basic Electrical Engineering-Circuits and Fields. 2 hrs and a 3-hr lab.

4670 Fundamentals of Vibration (3) Free and forced vibrations of damped and undamped lumped parameter systems; energy methods. Prereq: Dynamics 3rd quarter Elementary Linear Algebra and Calculus of Several Variables.


4810-20-30 Engineering Analysis (3, 3, 3) Introduction to methods of analysis with emphasis on application to realistic engineering problems. Prereq: Fluid Mechanics, Mechanics of Materials and Math 3150.

4850 Elementary Structural Matrix Methods (3) Stress Analysis, Deformations and Statically Indeterminate Structures, Math 3150. (Same as CE 4850 and Arch 4850.)

4910 Special Engineering Science Topics (3) Problems related to recent developments and practice. Open to juniors or seniors with consent of instructor. May be repeated. Maximum 6 hrs.

5000 Thesis

5110-20 Fluid Dynamics (3, 3) Kinematics of fluids, vorticity, rate deformation, plane and axially symmetric stream functions; Navier-Stokes equation, exact solutions, creeping flow and boundary-layer approximations; nonviscous flow, potential theory, complex potentials, conformal mapping. Prereq: Fluid Mechanics.

5130 Introduction to Turbulence (3) Macroscopic effects, analogies, statistical treatment, correlation functions, energy spectra, diffusion; application of turbulent jets and pipe flow. Prereq: Fluid Mechanics.


5180 Finite Element Structural Analysis (3) (Same as CE 5180.)
properties and materials. Prereq: Math 5630.

6800 Advanced Continuum Mechanics (3) Prereq: Math Engr. 5820 or M.E. 5410, or Met. Engr. 5840 or equivalent. (Same as Chem. Engr. 6830.)


8840 Nonlinear Mechanics (3) Development and solution of governing equations for nonlinear mechanical systems; free, forced and self-sustained vibrations; large deflections of strings, bars, and membranes; nonlinear particle dynamics. Prereq: 5900 and Math 4550.

6910 Special Topics in Engineering Mechanics (3) Selected advanced problems of current interest in mechanics, worked either as a group or individually. Prereq: Consent of instructor. May be repeated with consent of department.

Note: Not all of the above graduate courses will be offered in any one year.

Industrial Engineering

MAJOR

Industrial Engineering

M.E., M.S.

Professors:

D. C. Doulet (Head), M.S. Tennessee, P.E.;
H. P. Emerson (Emeritus), S.B. Massachusetts Institute of Technology, P.E.; R. M. LasForge, M.S. Georgia Institute of Technology, P.E.;
H. L. Loveless, M.S. North Carolina State, P.E.;

Associate Professors:

D. H. Hutchinson, Ph.D. Georgia Institute of Technology, P.E.;
J. M. Pike, Ph.D. Florida; J. A. Snider, Ph.D. Ohio State, P.E.;
W. G. Sullivan, Ph.D. Georgia Institute of Technology, P.E.;

Assistant Professors:

W. W. Claycombe, Ph.D. Virginia Polytechnic Institute, P.E.; J. D. Duncan, Ph.D. Kansas State University; M. L. Clarkson, P.E.;
M. K. Goodman, M.S. Tennessee, P.E.;
T. M. West, M.S. Tennessee, P.E.;

MASTER OF SCIENCE PROGRAM

A graduate program leading to the degree of Master of Science is open to graduates of recognized undergraduate curricula in industrial engineering or to graduates of other engineering curricula who take up to 15 quarter hours of prerequisite course work. A non-thesis option with 45 hours of course work plus a three-hour design project is available.

Graduate work in industrial engineering provides for concentrations in operations research, human factors, systems engineering, reliability, work measurement, facilities planning and engineering economy. Either one or two minors can be elected in engineering, mathematics, psychology, business, computer science, statistics or economics.

4060 Production and Inventory Systems (3) Fundamentals and applications of statistical forecasting for production planning, inventory analysis and control techniques, production planning and control, material requirement analysis, and production scheduling and control models. The overall production process as an integrated system. Prereq: Industrial Operations Research I and Indusial Operations Research II. Not available for graduate credit for Industrial Engineering students.

4080 Forecasting Methods in Industrial Engineering (3) Application of technological forecasting techniques to industrial engineering problems. Includes moving averages and exponential smoothing, linear and polynomial regression models, autocorrelated time-series analysis, Delphi methods and other selected industrial forecasting methods. Prereq: 4060.

4150 Project Control with CPM and PERT (3) A study of project planning and control based primarily on “critical path” techniques, including resource allocation, time cost trade-off analysis, computer programs. Prereq: Statistics 3450.


4170 Automatic Process Control (3) Characteristics of automatic processes and controllers; elementary open and closed loop analysis and control of industrial control systems. Prereq: Introduction to Differential Equations, and Dynamics.


4240 Determined Time Systems (3) Work design and measuring of a predetermined time system such as methods time measurement, time and motion study, or standard time factor. Theory and application. Prereq: Work Measurement.

4250 Work Measurement Applications (3) Application of learning curves, queuing theory, standard data methods and incentive systems to the design of industrial work situations. Prereq: Work Measurement.

4260 Engineering Economy (3) Methods and problems in the selection or replacement of equipment. Opinion and engineering economics, including capital recovery, economic life of equipment, and rate of return on investment. Not available for graduate credit for Industrial Engineering students.

4500 Case Studies in Engineering Economy (3) Extension of basic engineering economy principles to actual problems faced by competitive firms and regulated industries. Case studies taken from literature form basis of classroom discussion. Out-of-class assignment is made which involves working with local companies to evaluate, make or buy options, leasing versus cash purchases, equipment replacement studies, energy source economies, etc. Prereq: 4520.

4540 Industrial Development (3) Factors other than mechanical or chemical which enter into the successful establishment of manufacturing enterprises. Cost and market analysis to determine the commercial feasibility of new plants or projects.

4590 Simulation (3) Generation of output of a complex random process by computer. Modelling, simulation languages. Simulation as a design tool in industrial systems. Prereq: Computer Science 3150.

4810 Human Factors in Work Design II (3) Human factors and limitations affecting work place layouts, working environment, design of tools and equipment, and communications and response in man-machine systems.

Prereq: Work Measurement, General Psychology. Not available for graduate credit for Industrial Engineering students.

4830 Health Systems Engineering (3) A study of hospital management by means by which they may be improved through the application of modern industrial engineering principles and techniques. Prereq: Work Methods and Design.


4910-30 Special Industrial Engineering Topics (3, 3) Open with consent of instructor. May be repeated.

4950 Industrial Safety (3) Development of organization and programs for prevention and control of accidents with emphasis on OSHA Rules and Regulations.

5000 Thesis

5110 Work Design (3) Advanced methods analysis embodying the design and improvement of work systems, human factors, workers' responses and measurement. Prereq: Motion and Time Study or Work Methods and Design.

5210 Advanced Work Measurement (3) Characterization of some of the better known pre-determined time systems, application to formula construction, and practice in application. Prereq: Motion and Time Study or Work Methods and Design.

5240 Facilities Planning and Design (3) Modern facilities handling techniques, computer-aided layout techniques, applications of operations research models, and the use of these to design a manufacturing facility. Prereq: Production Facilities Planning.


5260 Information Systems Design (3) Systems engineering approach to information systems design. Topics include the system model, analysis and evaluation of information systems, information objectives and design criteria. Use of optimization and simulation in design system will be emphasized.

5340 Applied Decision Theory (3) Application of the theory of decision making to problems in industrial engineering. Approaches to decision making under conditions of incomplete information. Bayesian and Neyman-Pearson statistical decision models, utility functions, value of information, and quadratic loss analysis and parallel and sequential decision processes. Prereq: 4520 and 5520.


5520 Advanced Engineering Economy (3) Modification of engineering economy techniques for decisions under risk and uncertainty. Solutions to problems requiring evalu-
ation of intangibles, estimates of variation, and interpretation of variable results. Prereq: 4520, Statistics 3450.

5600 Human Factors Engineering (3) Study of the characteristics of man with emphasis on the design of comfort, safety, and productivity of the environments and products. Particular attention given to the modeling of man as a process or system controller. Prereq: Consent of instructor.

5610 Human Factors Engineering (3) The human operator, his performance characteristics, and his environmental requirements. Emphasis is given to the formal description of the human operator's transfer characteristics through both quasi-linear models and models describing the operator as an information processor. Prereq: 4510.

5700 Operations Research Methods in Engineering (3) An introductory course in operations research. Analytical techniques required in 5710, 5720 and 5730 are presented. Applications of classical optimization theory, N-dimensional geometry and the calculus of variations, to selected areas of operations research. Prereq: Math 4050.

5710 Linear, Quadratic and Dynamic Programming (3) An introduction to mathematical programming. Topics include linear programming, quadratic programming, and dynamic programming. Applications include computer solutions to programming problems. Prereq: 5700.


5730 Game Theory and Random Processes (3) Additional topics in operations research including game theory with applications to decision making in a competitive environment, and random processes with applications to queuing, inventory models and decision making. Prereq: 5700, Statistics 3450.

5810 Theory of Industrial Automatic Control (3) Basic elements of industrial control systems. Model analysis with Laplace and Z-transforms. The compensation technique using root locus and Bode plots. The student's advisor will assist in planning the program of study to ensure that it meets the DSS content requirement. Three programs are available.

5820 Mechanical and Aerospace Engineering

MAJORS

Aerospace Engineering M.E., M.S., Ph.D.
Mechanical Engineering M.E., M.S., Ph.D.

Professors:
M. W. Milligan (Head), Ph.D., Tennessee, P.E.; F. D. Bailey, Ph.D., Lehigh, P.E.; G. W. Braun, Ph.D., Gottingen; B. D. Berliner, Ph.D., Bethlehem, Germany; R. W. Holland, M.S., Tennessee, P.E.; R. L. Maxwell, M.S., Case, P.E.; W. K. Stair, M.S., Tennessee; J. Wu*, Ph.D., California Institute of Technology; L. R. Young*, Ph.D., Northwestern, P.E.

Associate Professors:

Professors:

G.S. A. Science Programs

Graduate programs leading to the degrees of Master of Science and Doctor of Philosophy with specialization in mechanical engineering or aerospace engineering are available to graduates of recognized undergraduate curricula in mechanical or aerospace engineering and to graduates of other curricula who satisfy the necessary prerequisites. The general policies and requirements of the Graduate School apply to these programs.

Departmental graduate programs are also available at the Space Institute, Tullahoma.

MASTER OF SCIENCE PROGRAMS

The student must satisfactorily complete a program of study which has been approved by the student's advisory committee.

1. The Thesis Program. The requirements are:

A. A minimum of 36 quarter hours of course work which includes at least 18 quarter hours of graduate (5000-level or above) courses in mechanical and/or aerospace engineering and normally nine quarter hours of course work (4000-level or above) in mathematics.

B. A minimum of nine quarter hours of credit in thesis.

C. Participate in the departmental seminar program.

D. Submit and defend a written thesis which demonstrates the ability to conduct and report on an independent investigation.

E. Pass a final examination on all work submitted for the degree.

2. The Course Program.

Normally, this program is restricted to those students who have had significant engineering work experience. The evaluation of the work experience and the final selection of the student's program of study are left to the student's advisory committee. The requirements are:

A. A minimum of 45 quarter hours of course work which includes at least 27 quarter hours of graduate (5000-level or above) courses in mechanical and/or aerospace engineering and normally nine quarter hours of course work (4000-level or above) in mathematics. No more than three quarter hours of engineering course work can be below the 5000 level.

B. Participate in the departmental seminar program.

C. Pass comprehensive written and oral final examinations on all
course work submitted for the degree. The student's committee will be of sufficient size to include at least 12 quarter hours of 6000-level credit and a doctoral dissertation beyond the Bachelor's degree, exclusive of credit in the DOCTORAL PROGRAM.

3. Participate in the departmental seminar program.

4. Pass a comprehensive written final examination on all course work submitted for the degree and an oral examination on all work (including problems) submitted for the degree.

DOCTORAL PROGRAM

Students applying for entrance into the doctoral program must display evidence of ability to perform and report independent study. The Master's thesis may be offered as such evidence. The student must satisfactorily complete an approved program of study which normally includes:

1. A minimum of 72 quarter hours credit beyond the Bachelor's degree, exclusive of credit for the M.S. thesis.

2. A minimum of 36 quarter hours of credit is doctoral dissertation.

3. A minimum of 16 quarter hours in mathematics in courses numbered 4000 or above.

4. A minimum of 36 quarter hours in mechanical or aerospace engineering courses numbered 5000 and above, with at least 12 quarter hours of 6000-level courses. These are exclusive of thesis or dissertation credit.

5. The student's doctoral committee determines if a reading knowledge of one or two languages is required.

6. Participate in the departmental seminar program.

GRADUATE CREDIT FOR NON-MAJORS

Junior (3000-level) and senior (4000-level) mechanical and aerospace engineering courses may be taken for graduate credit by non-mechanical or non-aerospace engineering majors, if approved by the student's major department. Mechanical or aerospace engineering majors may not normally use more than one 4000-level engineering course to meet their advanced degree requirements. Graduate students should consult with instructors regarding prerequisites for undergraduate courses.

Mechanical Engineering

3000 Energy—An Overview (4) Introduction to available energy resources, recovery and utilization; power generation techniques including conservation schemes; emphasis on the resources-environment-man interaction as related with energy; primarily for non-engineering students.

3110-20 Applied Engineering Thermodynamics (3, 3) Energy and laws governing energy transformations; thermodynamic properties; applications to engineering problems. Prereq: College physics and calculus.

3311 Engineering Thermodynamics (3) Energy and laws governing energy transformations; thermodynamic properties. Prereq: College physics and calculus.

3320-30 Engineering Thermodynamics (3, 3) Properties of gases and gas mixtures; chemical reactions; equilibrium; applications to mechanical and aerospace engineering problems. Prereq: College physics and calculus.

3410 Fluid Flow (3) Development of continuity, momentum and energy principles for fluid systems; applications to mechanical and aerospace engineering problems. Prereq: College physics and calculus.


3520-30-40 Thermal Sciences (3, 3, 3) Fundamental principles of engineering thermodynamics and transport phenomena as applied to engineering design. To be taken in sequence. Prereq: College physics and calculus.

3610 Mechanics of Machinery (3) Mechanisms, graphical methods; instanta-

3620 Mechanics of Machinery (3) Newton's laws; work, energy, impact; single degree vibrating systems. Prereq: 3910.

3630 Mechanics of Machinery (3) Multiple degree vibrating systems; static and dynamic forces; balancing; vibration isolation. Prereq: 3620, 3910.


3910 Engineering Analysis (3) Advanced analysis techniques for problems of aerospace and mechanical engineering. Emphasis on approxi-


4150 Energy Conversion Systems (3) Direct generation of electricity; operating and design characteristics of selected direct conversion techniques. Prereq: 3330, 3440, and 4510.

4160 Energy Conversion Systems (3) Economic and technical design parameters as applied to power plants for public utilities or industrial applications. Selected design and layout problems. Prereq: 4140 and 4420.

4170 Turbo-Machinery (3) Basic principles of turbo-machinery; systematic methods of analysis, design prediction. Prereq: 3530 or Aerospace Engineering 3510.

4180 Energy Production and Utilization (3) Thermodynamic constraints on energy production; comparison of power generation methods; evaluation of new energy sources and concepts; energy conservation schemes.

4220 Environmental Noise (3) Basic principles of acoustics—measurement and control of noise in industrial and community environments.


4471-81-91 Experimental Mechanical Engineering (3, 3, 3) Experimental methods and measurements including instrumentation, controls, analog devices, flow measurement, physical property measurement, testing standards and the planning, conducting, analyzing and reporting of experimental tests. Prereq. for 4471: 3330, 3410, 3440, and 3850; for 4481: 4471, 3330, 3440, and 4420.

4510 System Dynamics (4) Analytical models of physical systems, linearization, Laplace transforms, dynamic characteristics and stability of systems, numerical simulations, and analog computer solutions. Not for departmental graduate credit. Prereq: 3630 or Aerospace Engineering 3620.

4520-30 Creative Design (3, 3) Application of engineering principles to the solution of current problems with emphasis on design innovation.


4622 Tool Design (3) Principles underlying tool and die design, design of high-volume production tools and molds, work holding fixtures. Prereq: 4621.


4624 Manufacturing Engineering Systems Design (3) Design of manufacturing systems for a particular product: Manufacturing planning, tool and fixture design, selection of manufacturing operations, redesign of product to reduce cost.

4625 Manufacturing Process Engineering I (3) Product Specification: dimensional analysis of size and form; true position tolerance theory; tolerance analysis; and workpiece con-


4632 Application of Lagrangian Mechanics in Vibration Problems (3) Generalized coordinates and multiple degree of freedom vibrating sys-

4633 Matrix Analysis (3) Application of ma-

4660 Materials and Manufacturing Processes (3) Selection of materials and processes; re-


4680 Machine Design (3) Design of machinery; selection of materials; strength consider-


4710 Thermal Environmental Systems (3) Re-
To the mechanics of machining. Detailed treatment of basic phenomena-plastic flow, fracture, form filling, and wear. Prereq: Undergraduate metalsurgy and materials behavior, and heat transfer.


5840-50-60 Turbo-machinery Systems (3, 3, 3) Theory and practice of design, development and systems integration of turbo-engine components. Prereq: First-year graduate standing and consent of instructor.

5870 Dynamic Modeling and Simulation (3) Methods of modeling physical systems including mechanical, thermal, hydraulic, pneumatic and electro-mechanical systems. Techniques for experimentally determining system parameters. Analog and digital computer simulation techniques. Prereq: Undergraduate dynamics, heat transfer, and fluid mechanics.


5950 Seminars (1) Discussions on all phases of mechanical engineering, including reports on current research at The University of Tennessee, Knoxville. S/JC only. May be repeated.

5990 Special Topics in Mechanical Engineering (1-3) May be repeated.

6000 Doctoral Research and Dissertation

6110-20 Advanced Topics in Fluid Mechanics and Convective Transfer (3, 3) Same as Engr. Mech. 6110-20.

6130-40 Advanced Radiation Heat Transfer (3, 3) Radiation heat transfer in absorbing, emitting and scattering media; the interaction of thermal radiation with convection and convection heat transfer; radiation heat transfer in hypersonic flow; radiative characteristics of luminous flames and non-uniform gases; scattering by planetary atmosphere. Prereq: 5110-20 or equivalent.

6160 Engineering Vibrations (3) Linear and nonlinear single degree of freedom systems. Prereq: Consent of instructor.

6170 Engineering Vibrations (3) Multiple degree of freedom systems with lumped and distributed parameters. Prereq: Consent of instructor.


6510 Airplane Performance (3) Introduction to airfoil and wing characteristics, drag; propulsion; static performance and maneuvers; theory and design of control surfaces; stability. Prereq: 3510.

6550 Selected Topics in Aerospace Science (3) Current problems in aerospace science: topics in science and engineering required for an understanding of the several areas of aerospace science.

5000 Thesis

5110 Fundamentals of Aerodynamics (3) Kinematics and dynamics of perfect fluids; potential flow about a body; conformal mapping; hodographs. Prereq: 4220 or ME 5310, Math 4250.

5120 Experimental Methods in Fluid Mechanics (3) A study of experimental techniques with laboratory experiments on hydrodynamics, convective transport, boundary layer theory, and flow visualization. Prereq: 4471 or ME 5310, Math 4250.

5150-60-70 Air Vehicle Aerodynamics and Performances (3, 3, 3) Application of aerody-
5570 Aerospace Vehicle Flutter and Vibration (3, 3) Inertial and aeroelastic effects in aircraft. Analysis of flutter and buffet phenomena. Prereq: Consent of instructor.


5610 Applied Acoustics (3) Energy flow in acoustical systems, and the description of sound propagation in a nonhomogeneous moving medium, sound waves due to turbulence, vertical sound, pseudosound, propagation and absorption of sound in ducted and unconfined ducts. Prereq: Consent of instructor.

5620 Aeroacoustics (3) Special topics and recent research results in the field of aeroacoustics. Topics to be covered include: turbulence, machinery noise, jet noise, and general theoretical developments, as well as empirical equations. Prereq: 5610.

5810 Aviation Systems: An Overview (3) Aviation systems, effects and characteristics, with special emphasis upon the aviation systems approach. Consideration of the socio-economic base, aero- space, and propulsion technology, meteorology, air traffic control, airport-community interface, and technological trends and developments pertinent to the present status and future development of aviation. Prereq: Aircraft Propulsion & Performance 5210 for 5810, and 5810 for 5810.

5900 Selected Engineering Problems (3-9) Selected advanced topics in gas dynamics. The selection of topics will be based on the particular interests of the students registering for the course. Representative topics may include non-equilibrium transport phenomena, radiation gas dynamics, non-equilibrium gasdynamics, advanced turbulence techniques, and perturbation techniques. Prereq: Consent of instructor.

**Nuclear Engineering**

Major: Nuclear Engineering

Degrees: M.E., M.S., Ph.D.

Professors: P. F. Pasqua (Head), Ph.D. Northwestern, P.E.; J. B. Fussell, Ph.D. Georgia Institute of Technology; W. H. Jordan, Ph.D. California Institute of Technology; P. R. Kasten, Ph.D. Minnesota; T. W. Kerlin, Ph.D. Tennessee; H. G. MacPherson, Ph.D. California; J. E. Mott, Ph.D. Minnesota; J. C. Robinson, Ph.D. Tennessee; P. N. Stevens, Ph.D. Northwestern, P.E.

Associate Professors: T. Hoffman, Ph.D. Tennessee; H. C. Roland, Ph.D. Tennessee; O. L. Smith, Ph.D. Missouri.

Master of Science Program

A graduate program leading to a degree of Master of Science is available to graduates of recognized undergraduate curricula in engineering and physics. Each applicant will be advised as to the necessary prerequisite courses before he enters the program.

The student must complete a program of study of 45 quarter hours which has been approved by the student's advisory committee and which includes the following:

1. A major consisting of a minimum of 18 quarter hours of graduate courses in nuclear engineering.
2. A minor of nine quarter hours in mathematics.
4. Final examination covering the thesis and graduate course work.

An alternate program is available for the Master of Science degree which involves engineering practice rather than a thesis. The student must complete a program of study which includes the following:

1. Thirty-six quarter hours of course work similar to the requirements for the regular Master of Science program (see above).
2. Twenty-four quarter hours of Nuclear Engineering 5980, Nuclear Engineering Practice. A student usually registers for six hours of Nuclear Engineering 5980 each quarter and investigates problems assigned by a member of the faculty. At the end of each quarter the student submits a
written report and makes an oral presentation of his work.
3. Final examination covering graduate course work and practice school problems.

DOCTORAL PROGRAM

Students in the field of nuclear engineering desiring to study for the degree of Doctor of Philosophy must have a Bachelor of Science or Master of Science degree from a recognized university, with a major in engineering or physics, and present at least a B average. All candidates will be required to demonstrate a general competence in the preliminary examination in the areas of engineering science, mathematics, and physics. At the same time, all candidates will be required to demonstrate special competence in nuclear design.

Specific course requirements for the Ph.D. degree in Nuclear Engineering include:
1. A minimum of 72 quarter hours credit beyond the Bachelor's degree, exclusive of credit for the M.S. thesis or Nuclear Engineering Practice.
2. A minimum of 36 quarter hours of credit in doctoral research.
3. A minimum of 45 quarter hours in nuclear engineering courses numbered 5000 and above (or the equivalent), with at least 12 quarter hours of 6000-level courses. These are exclusive of thesis or dissertation credit.
4. A minimum of 18 quarter hours in mathematics or computer science in courses beyond nuclear engineering undergraduate requirements. Must be numbered 4000 or above.
5. A minimum of nine quarter hours in courses numbered 5000 or above from a department other than Nuclear Engineering. The choice depends on the student's overall program and should expand his knowledge in a given field.
6. A reading knowledge of one foreign language.

4110-20-30 Introduction to Nuclear Reactor Theory (3, 3, 3)
3. Nuclear structure; radioactive decay laws; neutron interaction; fission process, chain-reacting systems; diffusion equation including group diffusion theory; neutron moderation; reaction coefficients; perturbation theory. Prereq: Physics 3730 or consent of instructor.

4110-20-30 Transport Processes in Nuclear Engineering (3, 3, 3)
Transport coefficients of plasmas; plasma containment; plasma diagnostics; thermonuclear devices. Prereq: Physics 3730; Math 4550.

4210-20-30 Nuclear Engineering Laboratory (3, 3, 3)
Radiation detection and counting instrumentation; scattering statistics, half-life and decay schemes, gamma spectrometry, cross-section measurements, analog computation, diffusion properties of neutrons, critical loading experiments, control rod calibration, statistical weight, shielding, xenon poisoning, prompt critical reactor behavior, fission density and adjoint flux. Prereq or Coreq: 4110 or equivalent.

4530 Reactor Simulation Laboratory (3) Simulation of reactor design and operation with analog computer; reactor kinetics; single and multigroup theory; sensitivity coefficients; pol-sioning, control rod calibration; power reactor; subcritical assembly. Prereq: 4120.

4610-20-30 Nuclear Power Systems (3, 3, 3)
Nuclear structure, decay laws, neutron diffusion, time behavior of reactors, heat removal, analysis of reactor power plants; economic, safety, and environmental aspects of nuclear power. Prereq: Math 4610, non-nuclear engineering students only.

4710 Energy Transport (3)
Development of differential and integral energy conservation equations: conduction, convection, and radiation heat transfer; applications to nuclear reactor fuel elements and heat exchangers. Prereq: Momentum and energy transport.

4720 Reactor Thermal Design (3)
Hydrodynamics and heat transfer in boiling systems; boiling crises, reactor thermal design, steam generator design. Prereq: 4710.

4730 Nuclear Reactor Design (3)
First order reactor design, integration with non-nuclear heat transfer and power conversion system, economic evaluation, optimization procedures, description of typical systems. Coreq: 4130.

4810 Radiation Shielding (3)
Types of radiation sources, gamma ray and neutron attenuation, biological effects of radiation; shield design. Prereq: Physics 3730, Math 4550.

4820 Reactor Kinetics and Controls (3) Derivation of kinetic equations; basic kinetic parameters; transient response with feedback; control and protective systems. Prereq: 4110.

4840 Nuclear Reactor Safety (3)
Presentation of reactor safety concepts and criteria; credible accidents; fission product release and transport; containment systems; accident analysis; engineering safeguards. Prereq: 4120, Coreq: 4730 or consent of instructor.

4930 Nuclear Fuel Management (3) Discussion of problems associated with processing of nuclear materials fuel cycle analysis; burn-up calculation. Prereq: 4120.

5000 Thesis

5110-20-30 Transport Processes in Nuclear Engineering (3, 3, 3)
Momentum and heat transfer; development of conservation equations; elementary theory of turbulence; heat transfer and flow through conduits; conduction; radiation; reactor core thermal analysis. Prereq: 4720 or equivalent, Math 4710, 4550.

5210 System Dynamics (3) Transient analysis, Laplace transforms, frequency response, stability (linear and nonlinear), and sensitivity analysis by state variable methods. Dynamic analysis of distributed systems. Prereq: Consent of Instructor.

5220 Reactor System Dynamics (3) Application of methods of general system dynamics to reactor systems. Modeling of neutron and non-neutron processes. Dynamics, stability, and control of zero power reactors and power reactor systems. Prereq: 5210, 4130 or equivalent.


5240 Reactor Instrumentation (3) Principles and applications of instrument components and systems for the operation, control, and safety of nuclear reactors; role of instrumentation in public health and safety; engineered safeguards for nuclear power plants. Prereq: 4820, or consent of instructor.

5710-20-30 Nuclear Design (3, 3, 3) Development and application of analytical techniques for the neutronic aspect of nuclear reactor core design. Techniques considered are multigroup discrete ordinate theory, multigroup Pn theory, integral transport theory, perturbation theory, and others. The generation of the required multigroup constants is formulated starting with the available point data and using the Nordheim treatment in the slowing down region and gas kernel in the thermal region.

5740 Reactor Shielding (3) Application of analytic solutions of Boltzman transport equation to shield design problems. Spherical harmonics, moments methods, numerical solutions, integral calculations, and Consistent Immobilization cases studied. Prereq: 4810.


5840-50 Fast Breeder Reactors (3, 3) Special characteristics of fast breeder reactors, with emphasis on the LMFBR. The need for breeders; neutron physics and thermal characteristics of the reactor core; development status of engineering components; fuel cycle cost analysis; safety; coolants other than sodium; world status of development.

5910-20 Advanced Nuclear Reactor Design (3, 3) Factors affecting nuclear reactor design, and optimization with respect to performance criteria. Prereq: 4130 or equivalent, mechanical and thermal flow systems. Cycle, reactor plant cost estimating.

5970 Special Topics in Nuclear Engineering (3) Lectures and recitation on recent advances in nuclear engineering. Prereq: Consent of instructor. May be repeated with consent of department.

5980 Nuclear Engineering Practice (3-12) Experiences in solving and reporting on engineering problems. Prereq: Approval of the Nuclear Engineering Department. May be repeated. Only the Alternate Plan students may take this course. S/NC only.

6000 Doctoral Research and Dissertation

6110-20-30 Selected Topics in Reactor Theory (3, 3, 3) Special topics related to reactor theory such as transport theory, control rod theory, and perturbation theory. Selected topics from the literature. Prereq: Consent of instructor.

6140 Radiation Shielding (3) Advanced topics in radiation shielding. Monte Carlo techniques and space radiation problems. Natural space radiators, energy-source radiators, dose conversion, probability, etc. Selected neutron, gamma, and space-radiation shielding problems. Prereq: Consent of instructor.

6150 Reactor Dynamics (3) Special topics in reactor dynamics and control. Prereq: Math 5630.

6710 Two-Phase Flow and Heat Transfer (3) Pool boiling and flow boiling; hydrodynamics of two-phase flow, boiling crises, two-phase instabilities. Prereq: 5130 or equivalent.
Graduate study programs lead to the degree of Master of Science in Child and Family Studies; Consumer Studies and Housing: Public Policy; Crafts, Interior Design, and Housing; Food Science; Food Systems Administration; Home Economics Education; Nutrition; and Textiles and Clothing. Graduate study programs lead to the degree of Doctor of Philosophy in Home Economics with three options: Interdisciplinary, Food Science, and Nutrition. Graduate programs provide advanced specialized training needed for college and university teaching, for leadership positions in governmental and professional agencies, in the various professions in business, for secondary school and adult teaching, for research and for extended services.

GENERAL REQUIREMENTS FOR GRADUATE STUDENTS

Requirements for graduate study are prescribed by the Graduate School and by the student’s major department. Students lacking adequate preparation may be required to take additional courses at the undergraduate level as prerequisites to graduate study. A student deficient in English may be required to take courses as necessary to remove the deficiency.

APPLICATIONS FOR ADMISSION

Two copies of the student’s transcript and an application for admission are submitted directly to the Graduate School. In addition, a College of Home Economics application and three letters of reference are sent to the Associate Dean of the College of Home Economics. (Forms may be obtained from the college.) In submitting applications for admission to graduate study in Home Economics, students are requested to indicate choice of major area of study.

GRADUATE ASSISTANTSHIPS AND FELLOWSHIPS

Information and application forms regarding graduate assistantships, fellowships and general requirements for admission to graduate study may be obtained from the department chairman in the area of the student’s major interest or from the Associate Dean of the College of Home Economics for the interdisciplinary doctoral program.

PROGRAMS LEADING TO THE DEGREE OF MASTER OF SCIENCE

Thesis Option:

Majors and minors are offered in the following areas:

- Child and Family Studies
- Consumer Studies and Housing
- Public Policy
- Crafts, Interior Design, and Housing
- Food Science
- Food Systems Administration
- Nutrition
- Textiles and Clothing

Major (includes minimum of nine hours of 5000 courses) 18 hours
Thesis 9 hours
Collateral area(s) of study (includes minimum of six hours of 5000 courses) 18 hours

(Minimum of 18 hours of 5000-level courses exclusive of thesis.)

Total 45 hours

While the course requirements listed above are designed to meet the minimum program requirements, students may be permitted to substitute other courses at the discretion of the appropriate professors.

Note: Nine hours is the maximum credit allowed for special problems work and

*Requirements include Crafts, Interior Design, and Housing 5615 or Child and Family Studies 5170, Child and Family Studies 5700 or Planning 5100 or Economics 5340 or Agricultural Economics 4320; and Home Economics 5600.

Three-hour course in Research Methods or Statistics.

Twenty-four hours in Consumer Studies or Housing to include nine hours of Child and Family Studies 5000 or Crafts, Interior Design, and Housing 5000.

Consumer Studies courses to be selected from Child and Family Studies 5140, 5170, 5180, 5700, 6000, 5900, Crafts, Interior Design, and Housing 5120; Food Science 4040; Textiles and Clothing 5180; Agricultural Economics 4710; Economics 4340, 5050-60; Finance 5210-20; Political Science 5641, 5670-80, 5710; Library and Information Science 5250.

Twelve hours in an area of Home Economics other than the area (Consumer Studies or Housing) chosen above.

Minimum 27 hours in and nine hours outside College of Home Economics.

Minimum of 27 hours 5000-6000 level courses and total minimum of 45 hours.

Courses may be used to meet more than one requirement but all minimum requirements will need to be met.

In some instances two related collateral areas may be selected with nine hours in each area and a minimum of three hours of a 5000 course in each.

Collateral area(s) of study may be chosen in an area other than in home economics with the approval of the appropriate professors.

An oral examination is required.

Note: Nine hours is the maximum credit allowed for special problems work and
seminar work in any one area of home economics.

Non-Thesis Option:

The non-thesis option is available for all majors listed under the thesis option and is the only option available for Public Health Nutrition.

In addition to the regulations of the Graduate School, the non-thesis program of study for all majors except Consumer Studies and Housing: Public Policy requires that nine hours in one collateral area shall consist of 45 credit hours with a minimum of 24 hours in the major field and 18 hours at the 5000 and 6000 level. A minimum of 27 hours of 5000 and 6000-level courses is required in the program. Some majors may require nine hours in one collateral area.

Request for the non-thesis option must be made in writing by the student to the department chairman not later than the end of the first term in residence.

DOCTORAL PROGRAMS

The doctoral program in Home Economics provides three options for study: Interdisciplinary, food science, and nutrition. The Interdisciplinary option involves all departments in the College.

The doctoral program with a major in Home Economics requires:

1. A minimum of 96 quarter hours in courses beyond the Bachelor's degree exclusive of credit hours for the Master's thesis to include a minimum of 12 quarter hours of 5000-level courses.
2. Selection of an option and fulfillment of the requirements as supervised by the faculty committee.
3. The faculty committee for each doctoral student shall determine whether a reading knowledge of a foreign language is required.
4. Written preliminary examinations.
5. Doctoral research and dissertation (minimum 36 hours; maximum, 48 hours) may be included in the 96 hours presented for the degree.
6. A final examination.

Option Requirements:

Interdisciplinary Option:

1. Home Economics 6110-20, 6210.
2. Twenty-four to 36 hours from at least two departments in the College of Home Economics representing one of the following concentrations: Individual and Family Behavior as related to development and change throughout the human life cycle. Emphasis may be on: normal developmental processes, in individuals and families; socialization through childhood, adolescence, and adulthood; behavior in diverse environmental and cultural settings; interaction processes within families;

* Requirements include those listed under the thesis option for the major in Consumer Studies and Housing: Public Policy except that 21 hours are needed in Consumer Studies or Housing to include Home Economics 5000 (six hours), or Child and Family Studies 5000 or Crafts, Interior Design, and Housing 5000.

community services and planning to meet development needs of individuals and families.

Physiological Development and Well-Being in man throughout the life cycle. Emphasis for particular age groups may be on: physiological response to nutrient intake; improvement of nutritional status through informed community action; cultural, economic and technological influences on food selection. Environmental Factors—design, housing, food service systems, clothing, textiles, and crafts as they relate to human needs. Emphasis may be on the impact of: cultural, sociological, psychological, and economic change; technological developments; esthetics in improving the quality of the environment.

Consumers' Economic and Social Well-Being throughout the life cycle. Emphasis may be on the relationship between family structure and decision-making processes in the use of human resources; the effects of social, macro- and micro-economics and political development on consumption patterns and other behavior; community programs to meet the socioeconomic needs of consumers.

3. Fifteen to 24 hours in cognitive or supporting courses (mainly from departments in other colleges in the University) including courses to give sufficient competence in statistics or research methods needed for dissertation research. Additional courses will complement the option emphasis and dissertation research area.

4. Doctoral research and dissertation will be based on a problem within the interdisciplinary option concentration.

Food Science Option and Food Science with Concentration in Food Systems Administration:

1. Three hours in research methods from Food Science 5510 or 5520 or Food Systems Administration 5210; six hours from Food Science 5510-20-30-40, 6110, Food Systems Administration 6110; and Zoology 5350 (Biometry) or equivalent.
2. Twenty-four hours in 5000 and 6000 level courses in Food Science or in Food Systems Administration.
3. Nine hours in a collateral area (upon approval of student's faculty committee) in 5000 and 6000 courses in collateral area or may be substituted for 5000 and 6000 courses in Food Science or in Food Systems Administration.
4. Minimum of four hours of credit in doctoral seminar.

Nutrition Option:

1. Thirty hours of 5000 or 6000 courses in Nutrition exclusive of research

<table>
<thead>
<tr>
<th>DEGREES</th>
<th>MAJORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.S.</td>
<td>Child and Family Studies</td>
</tr>
<tr>
<td>M.S.</td>
<td>Consumer Studies and Housing: Public Policy</td>
</tr>
<tr>
<td>Ph.D.</td>
<td>Home Economics</td>
</tr>
</tbody>
</table>

SPECIAL WORKSHOPS

Workshops on special topics of current interest are offered periodically by the different departments in the College of Home Economics. These are of special interest to those desiring to work for advanced degrees. Announcements are sent upon request.

Each summer the craft workshop program in Gatlinburg, Tennessee, is made possible through cooperative efforts between the Crafts, Interior Design, and Housing Department and the Pi Beta Phi Arrowmont School of Crafts. The program provides advanced instruction in designer-created crafts through classes taught by nationally known craftsmen. Cooperation with national and local craft organizations has so stimulated the work of craftsmen throughout the area that their work has gained national recognition. See also page 86.

GRADUATE PROGRAMS FOR HOME ECONOMICS EXTENSION

Graduate programs at both the doctoral and master's levels are available for students interested in Home Economics Extension. At the doctoral degree level, programs of study may be planned in the Interdisciplinary or in the Food Science or the Nutrition options. At the master's degree level, the major in Consumer Studies and Housing: Public Policy is particularly suitable for students interested in Home Economics Extension, although master's programs may be planned in any subject matter area of Home Economics with Agricultural Extension Education as a collateral area. Additionally, four-week courses are offered in February each year for students particularly interested in Home Economics Extension. Students interested in a graduate program and/or the four-week courses should contact the Associate Dean of the College of Home Economics.

Departments of Instruction

Numbers in parentheses following the course titles indicate quarter hours credit offered.

Child and Family Studies

<table>
<thead>
<tr>
<th>DEGREES</th>
<th>MAJORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.S.</td>
<td>Child and Family Studies</td>
</tr>
<tr>
<td>M.S.</td>
<td>Consumer Studies and Housing: Public Policy</td>
</tr>
<tr>
<td>Ph.D.</td>
<td>Home Economics</td>
</tr>
</tbody>
</table>
Professor: R. L. Hightberger, Ph.D., Iowa.
Associate Professors: J. L. Cunningham, Ph.D., Michigan State; J. L. Kulpink, Ph.D., Michigan State; V. M. Nordquist, Ph.D., Tennessee; R. M. Swagler, Ph.D., Ohio State.
Assistant Professors: B. C. Miller, Ph.D., Minnesota; B. K. Miller, Ph.D., Michigan State; M. L. Rawlings, Ph.D., Pennsylvania State; H. M. Reed, M.S., Tennessee; S. Twardo, Ph.D., Kansas; M. Verzke, Ph.D., Wisconsin; P. White, Ed.D., Tennessee.

4110 Experiences in Preschool Programs (6) For majors in child development. Increasing responsibility for planning and guiding groups of children in the nursery school under direction of head teacher. Prereq: Program Planning for Preschool Children or Creative Experiences for Preschool Children. 2 hrs and 3 labs. (4 hrs each).

4210 Family Financial Problems (3) Analysis of alternate ways of meeting financial problems encountered during the family life cycle.

4220 Conserving Time and Energy in the Home (3) Emphasis on management principles to homemaking activities; evaluation of equipment, work centers and work procedures in terms of time and energy demands. Adaptations for the handicapped.

4230 Development in Infancy (3) Development during the prenatal period and first fifteen months of life. Interaction between infant and environment. Review of research relating to a child rearing practices and prediction of later behavior. Prereq: Human Socialization and Human Physiology, or equivalent.

4250 Development in Late Stages of Life Cycle (3) Adult life in our society. Adjustment to internal and environmental changes through middle and aged years. Prereq: Human Socialization, 3 hrs psychology, and 3 hrs sociology or equivalent.

4350 Advanced Child Development (3) Survey of selected theories relevant to child development with emphasis on research literature and research methods. Prereq: history of research relating to child rearing practices and prediction of later behavior. Prereq: Human Socialization and Human Physiology, or equivalent.

4420 Learning Experiences with Parents (3) Dynamics of parent-teacher interaction. Emphasis on a variety of techniques for developing communication and working relationships between parents and teachers through experiences in a variety of settings. Prereq: Observation and Experience in Preschool Programs or 4110 or equivalent.

4430 Family Relationships (3) Interpersonal relationships among family members and societal roles.

4610 The Child in the Community (3) Needs of children; community agencies meeting these needs; visits to agencies contributing to the welfare of children. Prereq: Human Socialization or equivalent.

4620 Administration of Programs for Young Children (3) Planning for the staff, housing, feeding, scheduling, and financing for day care of infants and young children, nursery school programs, and specialized programs for deprived preschool children. Prereq: 4110 or equivalent.

4630 Field Work in Child, Family and Consumer Studies (3-15) Opportunity for students to work in schools, community agencies; focus on children, families, and/or consumer concerns. Hrs arranged. May be repeated. Maximum 15 hrs.

4710 Contemporary Developments (1-3) A student or staff initiated course for study of a special topic or topics pertinent to the field; topics selected for study to be determined by students and instructor with departmental approval. Elective credit only. Prereq: Consent of instructor. May be repeated with consent of department head. Maximum 9 hrs.

4810 Afro-American Families (3) Historical background of minority group family structure and relationships; emerging needs and programs. Prereq: 4 hrs in social sciences.

4830 Consumers and the Market (3) Factors important to homemakers as family purchasing agents; specialization of goods; grading, branding, labeling; advertising; consumer practices affecting costs; specific household commodity information. Prereq: Principles of Economics.

4840 Generational Relations and Family Life Styles (3) The historical, economic, and social experiences of different generations, their influence on relations within and across generational groups, and implications for family life.

5000 Thesis 5060 Practicum (1-12) Field experience in selected agencies and organizations that focus on solutions to problems in Consumer Studies.

5110 Field Work in Family Life (3) School and community programs concerned with education for family living. Prereq: Consent of department head. May be repeated. Maximum 9 hrs.

5140 and Standards of Living (3) Economic and welfare aspects of consumption. Analysis of factors associated with changes in the standard of living. Review of major consumption studies. Prereq: CIOH 4320 or consent of instructor.

5150 Assessment of Family Behavior (3) Use and interpretation of methods of measurement related to the study of the family. Current methodological issues in the study of the family. Prerequisites: 5410 and 5530 or consent of the instructor.


5170 Consumer Economics (3) Consumer functions in the economy; structure of consumer markets; government action relating to consumer factors affecting prices of consumer goods.

5180 Management of Family Finances (3) Financial problems of families; adjustments necessary in family financial plans under changing conditions.

5210 Theories of Child Development (3) Major theories of child development. Prereq: 4350 or equivalent.

5220 Family Life Programs (3) School and community programs in family life; survey and evaluation; students concentrate on type best suited to their experience and future professional orientation. Prereq: 3 hrs child development, 3 hrs family relationships, 3 hrs sociology, 2 hrs and 1 lab.

5310 Theory and Research on Human Sexuality (3) Ethical, emotional, and psychological dimensions of human sexuality. Review of major contributions from anthropological, sociological, and personality theory and research.

5410 Advanced Family Relationships (3) Problems in family relationships; individual adjustments, group relationships.

5420 Parents and Children (3) Discussion of common problems of young children faced by parents and teachers with particular emphasis on methods available to modify problem behavior.

5430 Interaction in Emotionally Disturbed Families (3) Interpersonal transactions in disordered family behavior. Prereq: 5410 or equivalent.

5510 Survey of Research in Child and Family Studies (3) Review, evaluation, discussion of research literature; locating, abstracting, reporting research studies. Prereq: 5550 or equivalent.


5540 Teaching-Learning Process in Preschool Programs (3) Multidimensional aspects of teacher's role in nursery school and day care programs. Emphasis on guiding children in groups. Prereq: Previous experience in a laboratory nursery school and consent of instructor. 3 hrs and 1 lab (2 hrs).

5550 Supervision in Preschool Programs (3) Emphasis on guidance of students working in nursery school and day care centers. Guiding students through seminar discussion, individual conferences and various evaluation techniques. Prereq: 5540; 3 hrs and 1 lab (2 hrs).

5610 Theories of Management in the Family Environment (3) Examination of fundamental management concepts, their development and application to current family situations.

5620 Nursery School Administration (3) Organizing and operating schools and play groups for preschool children. Housing, staff, schedules, programs, financing, etc. Prereq: 4110 or equivalent.

5630 Seminar in Infant Development (3) Theory and research relating to development during infancy. Prereq: 4230.

5640 Teaching Child and Family Studies (5) Seminar and practicum in techniques for teaching an understanding of child development and family relationships. Prereq: Consent of instructor. S/C only.


5800 Problems in Child, Family and Consumer Studies (1-3) Advanced study selected from the field of child development and family variables in family planning programs, internships in planned parenthood programs and clinic. May be repeated. Maximum 9 hrs.

5840 Family Planning Programs (3) Community and family planning programs. Internships in planned parenthood programs and clinics. May be repeated. Maximum 9 hrs.

5900 Seminar in Child and Family Studies (1-3) Prereq: Consent of instructor. May be repeated. Maximum 9 hrs.


6250 Advanced Topics (3) Comprehensive individual study of selected topics related to current problems in the areas. Prereq: Consent of the Instructor. May be repeated. Maximum 9 hrs.

6310 Individual and Family Development. Physiological Determinants (3) Selected aspects
of family members' physiological potential, development, and status. The family's contribution to members' physiological potential is influenced by factors such as growth and development and the realization of human potential. Prereq: 6 hrs in advanced child and family studies, 4 hrs nutrition, 4 hrs psychology, or equivalents.

6320 Individual and Family Development: Cognition (3) Processes through which the human individual learns to recognize his world. Emphasis on cognitive processes involved in development across the life span with focus on research findings and methodology. Prereq: 5210, 5530, 5630, or equivalents.

6330 Individual and Family Development: Socialization (3) Processes of socialization throughout the life cycle. Focus on the family as a primary socializing agent. Prereq: 5210, 5410, or equivalents.

6410 Theories of Family Interaction (3) Review of theories in the child's social community. Both emphasis on critical evaluation of theoretical formulations of contemporary research on family behavior. Prereq: 5410 or equivalent.

6450 Conceptual Frameworks for the Family (3) Theoretical bases for understanding families. Exploration and applications of frameworks on both theoretical and research levels. Historical to contemporary development of family studies. Prereq: 5410 or consent of instructor.

6540 Seminar in Programs for Infants and Preschool Children (3) Exploration of research related to programs for infants and young children. Evaluation of various program models for education of infants and young children, methods of working with parents, and student training programs. Prereq: 5210, 5540 or equivalent.

6610-20 Contingency Management Programs for Disadvantaged Children (6, 6) Direct application and evaluation of methods designed to modify variant behavior exhibited by children from disadvantaged families. Students will receive supervision in organizing and training agents in the child's social environment. Both students' and agents' behavior will be guided by principles derived from operant reinforcement theory. Prereq: 5420. May be repeated.

Crafts, Interior Design, and Housing

MAJORS

DEGREES

Crafts, Interior Design, and Housing

M.S.

Public Policy

M.S.

Home Economics

Ph.D.

Professors:
R. G. Blium (Head), Ph.D. Florida State;
L. Bower, Ph.D. Syracuse; J. Falsetti, M.A.
Ohio State; M. G. Heard (Director, Arrowmont
School of Crafts), A.M. Columbia.

Associate Professors:
L. M. Mamer, M.S. Iowa State;
W. Moran, M.S. Wisconsin.

Assistant Professors:
S. Blaine, M.F.A. Wisconsin; R. Danheit,

Lecturers:
M. Baidridge, M.F.A. Cranbrook Academy of
Art; K. Bates, B.S. Massachusetts School of
Art; E. Bringe, Southwestern; E. Caldwell,
Ed.D. Columbia; S. South Carolina;
G. Crockett, M.A. San Jose State;
M. F. Davidson, M.Ed. Duke; N. Getty,
M.F.A. Florida; P. Grayson, Kingsport;
V. I. Harvey, Washington; P. E. Hassler,
M.S. Tennessee; J. Illman, B.F.A. Syracuse;
A. Lesch, M.Ed. Louisiana State;
M. F.A. Indiana; N. Minkowitz, Cooper Union
Art School; E. Motty, M.F.A. Tyler; E. Murphy,
M.F.A. Kansas; J. Paze, Marquette;
Sister M. Remy Revor, M.F.A. Art Institute
of Chicago; H. Rigger, M.A. Ohio State;
J. Riss, M.F.A. Cranbrook; J. Rushfelt,
M.F.A. Kansas; J. Schrader, M.F.A. Cranbrook;
M. Shatzman, M.A. Temple; M. S. Tennessee;
A. Van Aken, M.S. Tennessee; D. Van Dommelen, M.A. Michigan State;
M. Whisnant, M.S. Tennessee; D. Wyckoff,
Ed.D. Columbia.

To be admitted to the Graduate School in the craft program a student must have a professional knowledge of media and technique. Work with creative design concepts is emphasized at the graduate level; media and technique are immediately available only so far as the experimentation with these contributes to the philosophical and creative orientation of the designer-craftsman. Courses are, therefore, based on theory or philosophical concepts in order to facilitate the development of visual sensitivity in relation to design. Major emphasis will be on the visual image as a personal interpretation of the media. Because the philosophical orientation of the student varies widely, progression from one level to another is based on the understanding and communication of visual concepts. A student's course of study includes intensive training in his chosen areas of specialization such as metalwork, ceramics, weaving, textile design, or interior design as well as courses dealing with the broader aspects of design. All student programs include: Seminar in Design (5040), Advanced Design Studio (5050), and research methods; in addition, crafts majors include Exhibition Design (4140).

ARROWMONT SCHOOL OF CRAFTS

Graduate students in the area of crafts have a unique opportunity to participate in the summer program at the Arrowmont School of Crafts, Gatlinburg, Tennessee; credit is granted through The University of Tennessee, Knoxville. Instructors at the school are nationally and internationally recognized designer-craftsmen who offer, in many instances, approaches different from those of the resident faculty; this further enriches the student's program of study. Therefore, students are required to attend the Arrowmont School of Crafts during the summer term(s) and to pay the additional registration, tuition, and laboratory fees for which that School.

ACQUISITIONS AND EXHIBITIONS

The department reserves the right of acquisition and exhibition of work completed in its studios under the guidance of the faculty. Prospective graduate students should submit a portfolio of their undergraduate studio work to the department. This portfolio may include slides or original work.

4110 Home Wiring and Lighting Requirements (3) Service of electricity in modern homes; evaluation of lighting and wiring plans in terms of family desires and need for equipment; 1 hr and 2 labs.

4120 Contemporary Design (3) Furnishings and interiors; economic, technological and sociological influences on the development of interior design; changing living conditions; interaction of architecture and furnishings. Significant designers and their work.

4140 Exhibition Design (4) Display of Craft and Interior Design problems in relation to materials, props and special exhibition areas. Emphasis on the knowledge and application of the design principles as they relate to promotion, design construction, display and evaluation for two and three dimensional displays. Annual student Craft and Interior Design exhibit during quarter. Prereq: Consent of instructor.

4155 Interior Space Planning I (6) Analysis, planning and design of the office environment; includes contract specifications.

4156 Interior Space Planning II (6) Studio problems involving large scale non-residential interior spaces such as restaurants, transportation facilities, stores, institutions, etc. Prereq: 4155; consists of instruction and problem solving for one academic quarter.

4310 Crafts in America (3) Craft movement; factors that contributed to growth and development. Educational, social, economic, recreational and therapeutic values of crafts. Place of craftsman in society as producer, teacher, designer for industry.

4320 Family Housing Problems (3) Housing requirements of families. Reading and judging house plans; effective use of space; maintenance problems; housing regulations and restrictions; site selection and neighborhood development; financing procedures. Prereq: Principles of Economics.

4330 Care and Repair of Household Equip- ment (3) Care of equipment to give maximum service in relation to operation and service cost; understanding of common repair problems. Prereq: Equipment in the Home. 1 hr and 2 labs.

4410 Craft Media (4) Possibilities and limitations of craft media; understanding educational and social values of craft work. Designing and executing craft problems using inexpensive materials and tools. 3 labs.

4420 Leather Design (4) Relationship of design to function, techniques and materials. Creating leather objects of original design. 1 hr and 2 labs.

4430 Plastics (4) Possibilities and limitations of various plastics; methods of fabrication; relation of design to function, processes, types of material and use of tools. 1 hr and 2 labs.

5000 Thesis

5040 Seminar in Design (3) Intensive reading, discussion and critical evaluation of 20th century design concepts, the men, the motivation and the creative components leading to visual innovation.

5050 Advanced Design Studio (3) Studio experience planned to explore strengths, structural variability, and form potentials of design materials, searching for aesthetic potential in depth.

5060 Practicum (1-12) Field experience in selected agencies and organizations that focus on solutions to problems in housing.

5120 Historic Interior Design (3) Emphasis is placed on research studies of historic design developments. A variable content course with emphasis on interior design furniture and/or accessories for England, Scandinavia, Mediterranean area and/or America. May be repeated. Maximum 18 hrs.

5210 Furniture Appreciation (3) Aesthetic qualities of past and present styles. Study of significant structural and formal characteristics.

5310 Interior Design (3) Advanced problems in the planning and design of interior space; includes application of research information in interior design decisions. Prereq: Consent of instructor.

5330 Craft Design (3) Fine design in international crafts; designing in basic craft media. 1 hr and 2 labs.
5341-51-61 Metal Design I, II, III (4, 4, 4) 5341—Initial development of theory for investigation of aesthetic concepts in two and three dimensional forms in metal design. 5351—Advanced experimentation using aesthetic concepts in the development of two and three dimensional forms in metal design. 5361—Experimentation in unifying aesthetic concepts in preparation for the graduate exhibition. Prereq: Previous work in metal design and consent of department head. Each course may be repeated one time.

5342-52-62 Weaving I, II, III (4, 4, 4) 5342—Initial development of theory for investigation of aesthetic concepts in two and three dimensional forms in fiber constructions. 5352—Advanced experimentation using aesthetic concepts in the development of two and three dimensional forms in weaving. 5362—Experimentation in unifying aesthetic concepts in preparation for the graduate exhibition. Prereq: Previous work in textile design and consent of department head. Each course may be repeated one time.

5343-53-63 Textile Design I, II, III (4, 4, 4) 5343—Initial development of theory for investigation of aesthetic concepts for the surface decoration of textiles. 5353—Advanced experimentation using aesthetic concepts in the surface decoration of textiles. 5363—Experimentation in unifying aesthetic concepts in preparation for the graduate exhibition. Prereq: Previous work in textile design and consent of department head. Each course may be repeated one time.

5344-54-64 Wood Design I, II, III (4, 4, 4) 5344—Initial development of theory for investigation of aesthetic concepts in two and three dimensional forms in wood. 5354—Advanced experimentation using aesthetic concepts in the development of two and three dimensional forms in wood design. 5364—Experimentation in unifying aesthetic concepts in preparation for the graduate exhibition. Prereq: Previous work in wood design and consent of department head. Each course may be repeated one time.

5345-55-65 Enameling I, II, III (4, 4, 4) 5345—Initial development of theory for investigation of aesthetic concepts in two and three dimensional forms in enameling. 5355—Advanced experimentation using aesthetic concepts in the development of two and three dimensional forms in enameling. 5365—Experimentation in unifying aesthetic concepts in preparation for the graduate exhibition. Prereq: Previous work in enameling and consent of department head. Each course may be repeated one time.

5346-56-66 Plastics I, II, III (4, 4, 4) 5346—Initial development of theory for investigation of aesthetic concepts in two and three dimensional forms in plastic. 5356—Advanced experimentation using aesthetic concepts in the development of two and three dimensional forms in plastic. 5366—Experimentation in unifying aesthetic concepts in preparation for the graduate exhibition. Prereq: Previous work in plastics and consent of department head. Each course may be repeated one time.

5347-57-67 Ceramics I, II, III (4, 4, 4) 5347—Initial development of theory for investigation of aesthetic concepts in two and three dimensional forms in ceramics. 5357—Advanced experimentation using aesthetic concepts in the development of two and three dimensional forms in ceramics. 5367—Experimentation in unifying aesthetic concepts in preparation for the graduate exhibition. Prereq: Previous work in ceramics and consent of department head. Each course may be repeated one time.

5368 Ceramics—Glaze Calculation (4) Experimentation with various types of clay bodies and glazes for reaction and oxidation firing atmospheres. Prereq: Previous work in ceramics and consent of department head. May be repeated. Maximum 8 hrs.

5369 Ceramics—Kiln Construction (4) Investigation of designs for and construction of various sizes and types of kilns and burner systems which promote reduction and oxidation firing atmospheres. Prereq: Previous work in ceramics and consent of department head. May be repeated. Maximum 8 hrs.

5410 Advanced Problems (3) Individual development of techniques and appreciation. Prereq: 9 hrs Related Art or equivalent.

5510 Environmental Factors in Interior Design (3) Study of human factors and associated research techniques as they relate to the design of interior architectural environments. Emphasis on the derivation of design implications from anatomy, physiology, anthropology, and the behavioral sciences. Prereq: 6 hrs behavioral science, and 6 hrs natural science or consent of instructor.

5520 Environmental Factors in Interior Design (3) Study of systematic design methodology as applied to the design of micro-environments using human factors information. Prereq: 6 hrs behavioral science, and 6 hrs natural science or consent of instructor.

5530 Environmental Factors in Interior Design (3) Human factors and systematic design methodology applied to the analysis, synthesis and evaluation of research oriented interior design projects. Comprehensive design research project to be carried out by 2 or 3 member teams. Prereq: 6 hrs behavioral science, and 6 hrs natural science or consent of instructor.

5540 Environmental Factors in Interior Design (3) Human factors and systematic design methodology applied to the analysis, synthesis and evaluation of research oriented interior design projects. Comprehensive design research project to be carried out by 2 or 3 member teams. Prereq: 6 hrs behavioral science, and 6 hrs natural science or consent of instructor.

5610 Furniture Design (3) Analysis of human factors data in the design of body support, task support, and storage furniture pieces and systems; emphasis on the production of construction drawings and scale models. Prereq: Consent of instructor.

5615 Housing Programs and Policies (3) Analysis of private and public programs and policies designed to promote realization of suitable homes and living environments for families. Economic and social problems related to national housing objectives. Prereq: 4320 or consent of instructor.

5620 Experimental Methods in Household Equipment (3) Research methods and techniques used in determining performance of household equipment. Prereq: Equipment in the Home or consent of instructor. 1 hr and 2 labs.

5630 Environmental Requirements for Family Work Centers (3) Trends in planning work center areas such as for kitchens and laundries; evaluation in terms of adequacy, convenience, and facilities for their development and layout; problems of installation and remodeling.

5810-20-30 Problems in Related Art, Crafts, and Interior Design (1-3, 1-3, 1-3) Advanced study selected from any field of RACID. Prereq: Consent of departmental head and professor in charge of investigation.

5910-20-30 Seminar in Related Art, Crafts, and Interior Design (1-3, 1-3, 1-3) Prereq: Consent of instructor.

Courses offered periodically only at the Arrowmont School of Crafts, Gatlinburg, Tennessee. Courses may be repeated.

3311 Metal Design (1-4)
3321 Metal Design (1-4)
3331 Metal Design (1-4)
3411 Weaving (1-4)
3421 Weaving (1-4)
3431 Weaving (1-4)
3511 Textile Design (1-4)
3521 Textile Design (1-4)
3611 Wood Design (1-4)

3621 Wood Design (1-4)
3711 Enameling (1-4)
3721 Enameling (1-4)
4311 Crafts in America (1-4) (Same as 4310.)
4411 Craft Media (1-4) (Same as 4410.)
4421 Leather Design (1-4) (Same as 4420.)
4431 Plastics (1-4) (Same as 4430.)
4511 Ceramics (1-4)
4521 Ceramics (1-4)
4531 Ceramics (1-4)
4621 Studio Problems in Leather Design (1-4)
4631 Studio Problems in Metal Design (1-4)
4641 Studio Problems in Weaving (1-4)
4651 Studio Problems in Textile Design (1-4)
4661 Studio Problems in Wood Design (1-4)
4671 Studio Problems in Enameling (1-4)
4681 Studio Problems in Plastics (1-4)
4691 Studio Problems in Ceramics (1-4)
5331 Craft Design (1-4) (Same as 5330.)
5411 Advanced Problems (1-4) (Same as 5410.)
5441-51-61 Metal Design (1-4, 1-4, 1-4) (Same as 5341-51-61.)
5442-52-62 Weaving (1-4, 1-4, 1-4) (Same as 5342-52-62.)
5443-53-63 Textile Design (1-4, 1-4, 1-4) (Same as 5343-53-63.)
5444-54-64 Wood Design (1-4, 1-4, 1-4) (Same as 5344-54-64.)
5445-55-65 Enameling (1-4, 1-4, 1-4) (Same as 5345-55-65.)
5446-56-66 Plastic (1-4, 1-4, 1-4) (Same as 5346-56-66.)
5447-57-67 Ceramics (1-4, 1-4, 1-4) (Same as 5347-57-67.)
5811-21-31 Problems in Related Art, Crafts, and Interior Design (1-4, 1-4, 1-4) (Same as 5810-20-30.)
5911-21-31 Seminar in Related Art, Crafts, and Interior Design (1-4, 1-4, 1-4) (Same as 5910-20-30.)

Food Science, Nutrition, and Food Systems Administration

MAJORS
Food Science M.S.
Nutrition M.S.
Food Systems Administration M.S.
Home Economics Ph.D.

Professors:
M. R. Gram (Head), Ph.D. California (Berkeley); R. E. Beauchene, Ph.D. Kansas State; J. R. Savage, Ph.D. Wisconsin; J. T. Smith, Ph.D. Missouri.

Associate Professors:
5140 Foods and Nutrition: Physicochemical Principles (3) Introduction to thermodynamics; physical and chemical properties of proteins, carbohydrates and lipids; chemistry of the collodion state; chemical kinetics; specialized kinetics of enzymatic processes. Prereq: Nutrition 3330 and College Algebra or equivalent.

5510 Food Sensitivity (3) Classification of foods according to textural parameters; use of instrumentation in the evaluation of textures. Prereq: 4010 or Food Technology 4290; statistics; or consent of instructor.

5520 Food Sensory Testing Methods (3) Principles and methodology of sensory evaluation of food; application of the methods; analysis of sensory data. Prereq: 4010; statistics; or consent of instructor.

5530 Advanced Experimental Food Science (3) Application of research methods to individual problems. Prereq: 5510-20 or consent of instructor.

5550 Food Behavior of the Individual (3) Development of and changes in the choices of food and in food habits of the individual. Prereq: 4000, 3 hrs of Nutrition, or consent of instructor.

5560 Foodways in the United States (3) Current foodways of selected sub-cultures in the United States and the historical basis for their development. Prereq: 4000, 3 hrs of Nutrition, or consent of instructor.

5610-20 Advanced Food Science (3, 3) Biochemical and physical interactions in food. Must be taken in sequence. Prereq: 4010; Nutrition 3320 or equivalent, or consent of instructor.

5630 Carbohydrates and Fats in Relation to Food Science (3) Physical and chemical characteristics of sugars, starches and fats with emphasis on their behavior in food. Prereq: 4010; Nutrition 3320-30 or equivalent.

5640 Proteins in Relation to Food Science (3) Physical and chemical characteristics of the proteins of milk, eggs, flour and meat with emphasis on their behavior in food. Prereq: 4010; Nutrition 3320-30 or equivalent.

5700 Current Problems and Trends in Food Science (1-3) Recent advances in food science, their impact on curricular considerations, and their implications for teachers, extension workers, and dietitians. Prereq: Consent of instructor. May be repeated.

5800 Problems in Food Science (1-3) Advanced study from the field of food science. Prereq: Consent of department head and professor in charge of investigation. May be repeated.

5850 Field Experience (3-9) Experience in a food-related industry or agency under the supervision of a faculty member. Prereq: Consent of instructor. May be repeated.

6000 Doctoral Research and Dissertation

6110 Advanced Topics in Food Science (3) Comprehensive individual study and group discussion of topics related to current research in food science. Prereq: Consent of instructor. May be repeated.

6120 Food Dispersions (3) Physical characteristics of solutions, colloidal dispersions, and emulsions in relation to treatments applied. Prereq: 5530.

6150-20 Structure of Food Plants and Animal Tissues (3, 3) Histological structure of food plants and animal tissues as related to physical characteristics and chemical properties of their components. Prereq: 5630-40.

6200 Nutritional Factors in Relation to Body Fluids, Growth, Transport and Endocrine Function (3) Prereq: Nutrition 3330 and College Algebra or equivalent.


6310 Community Nutrition (3) Nutrition problems and practices in the community; supervised field work. Prereq: 5 hrs Science of Nutrition; consent of instructor. 3 labs.

6320 Community Nutrition (3) Observations and participation in nutrition programs of local and state agencies. Prereq: 5310 and consent of instructor. 3 labs.

6330 Community Nutrition (3) Nutrition programs of state and federal agencies; preparation of material for nutrition education; supervised field work. Prereq: Consent of instructor. 3 labs.

6340 Field Study in Community Nutrition (1-12) Personal participation in and analysis of a state or regional community nutrition program. Prereq: 5 hrs Science of Nutrition. Must be selected in consultation with the instructor. Prereq: 5320 and consent of instructor. S/NC only.

6350 Mental Retardation or Other Developmental Disorders of Childhood (3) Multidisciplinary core course required of all full-time students in training at the Child Development Center, UT Center for the Health Sciences, Memphis. Prereq: Consent of the department head.

6410-20 Human Nutrition (3, 3) Functions of carbohydrates, proteins, fats, minerals and vitamins. Nutritional requirements of man throughout the life span and practical problems in meeting requirements. Prereq: 5 hrs Science of Nutrition; 5110.

6430 Physiological Bases for Diets in Disease (3) Developments in the dietary treatment of disease in which nutrition plays a major role. Prereq: 5210 or equivalent.


6450 Survey Methods in Human Nutrition (3) Food consumption, food practices and nutritional status of population groups. Prereq: 5210 or 5410-20. 2 hrs and 1 lab.

6460 World Food Supply and Human Nutrition (3) Food supplies and food practices as related to hunger, poverty, and malnutrition. Prereq: 5210 or 5410-20.
to human nutrition throughout the world. Regional, national and international agencies concerned with food and nutrition problems. Prereq: 5210 or 5410-20.

5470 Nutrition and Aging (3) Nutritional problems of the aging individual. Emphasis on nutritional and energy needs of the elderly, dietary intakes and the effect of nutrition on the rate of biological aging. Prereq: 5210 or consent of instructor.

5510 Nutrition in Mental Retardation and Developmental Disabilities (1-12) Orientation to, observation of and participation in the interdisciplinary diagnosis and treatment of the developmentally handicapped child. Emphasis is given to the role of the nutritionist and the dietitian. Field experience and courses at the Child Development Center. Prereq: Consent of instructor.

5700 Current Programs and Trends in Nutrition (1-3) Discussion of selected recent developments in field of nutrition and their implications for teachers, extension workers, dietitians, public health nutritionists, and others in related fields. May be repeated. Maximum 9 hrs. Prereq: Consent of instructor.

5800 Problems in Nutrition (1-3) Advanced study selected from the field of nutrition. Prereq: Consent of department head and professor of charge. May be repeated. Maximum 9 hrs.

5890-60 Seminar (1, 1) May be repeated.

6000 Doctoral Research and Dissertation

6110 Proteins and Amino Acids (3) Lectures, reports and discussions. Prereq: 5410-20.

6120 Mineral Metabolism (3) Lectures, reports and discussions of functions of minerals in physiological processes. Prereq: 5410-20.

6130 Lipid Metabolism (3) Lectures, reports, and discussions. Prereq: 5410-20.

6140 Vitamin Metabolism (3) Lectures, reports and discussions. Prereq: 5410-20.

6210 Advanced Topics in Nutrition (1-3) Discussion of recent advances, concepts, research techniques and current problems. Prereq: 5410-20 or consent of instructor.

6900 Seminar (1-3) May be repeated. Maximum 9 hrs. S/NC only.

Food Systems Administration

4130 Food Systems Administration (3) Functions of management applied to food service systems. Prereq: Quantity Food Procurement, Production and Service.

4140 Food Systems Personnel Development (3) Development of training programs for food systems personnel. Prereq: 4130 or consent of instructor.

4150 Design and Layout of Food Service Systems (3) Physical fitness equipment for food service systems based on needs of the system. Procedures for purchasing equipment. Prereq: Quantity Food Procurement, Production and Service, or consent of instructor.


4260 Food and Lodging Physical Plant, Planning and Maintenance (4) Feasibility, planning, development and construction of food and lodging physical plant and maintenance. Electrical, plumbing, air conditioning and ventilation and illumination systems. Types of building materials and construction. Interdisciplinary with Home Economics and Architecture. Prereq: Quantity Food Procurement, Production and Service; 4150; or consent of instructor, 3 hrs and 1 lab. (Same as Architecture 4260)

4270 Food and Lodging Information Systems (3) Qualitative and quantitative analysis of information systems concerning making in food and lodging operations. Prereq: Food Systems Administration; Electronic Data Processing.

5000 Thesis

5110-20 Experimental Food Quantity Study (3) Analysis of food production, holding environment, and service problems related to quality control. Prereq: 5210, Research Methods. May be repeated. Maximum 9 hrs. Prereq: Consent of instructor.

5230 Food Systems Evaluation (3) Determination of productive capacity, efficiency and effectiveness in food service systems. Prereq: 4130, or consent of instructor.


5310 Administration of Food Service Delivery Systems (3) Role, responsibilities and policies of the administrator in maintaining desired qualitative and quantitative standards in a food service delivery system. Prereq: Quantity Food Procurement, Production and Service or consent of instructor.

5500 Clinical Training in Health Care Agencies (3) Instructional and supervisory techniques utilized in clinical settings by nurses and dietitians for the training of entry-level health care providers. Prereq: Management of Health Care or 4140 or consent of instructor.

5700 Current Programs and Trends in Food Systems Administration (1-3) Recent advances in food systems administration and their implications for dietitians, school food service directors and others in related fields. Prereq: Consent of instructor. May be repeated.

5800 Problems in Food Systems Administration (1-3) May be repeated.

5850 Field Experience (3-9) Field experience in selected organizations that focus on interdisciplinary solutions to multifaceted problems of society. Prereq: Consent of instructor. May be repeated. Maximum 12 hrs.

5900 Seminar in Food Systems Administration (1-3) May be repeated.

6100 Advanced Topics in Food Systems Administration (3) Comprehensive individual study and group discussion of topics related to current problems in food systems administration. Prereq: Consent of instructor.

6210 Manpower Planning and Training for the Food Service Industry (3) Identification of manpower needs by skill levels; planning and evaluation of programs for personnel in food service industry. Prereq: 4140, 5210 or consent of instructor.

6310-20 Quantitative Methods to Control Resources in Food Service Systems (3, 3) Interrelationships of resources and evaluation of their efficiency and effectiveness in food service systems. Prereq: 5230 or consent of instructor. Taken in sequence. Credit for 6310 contingent upon completion of 6320.

6900 Seminar (1-3) May be repeated. S/NC only.

College of Home Economics 89

Home Economics

MAJOR

Home Economics

DEGREE

Ph.D.

Professors:

L. M. Odland (Dean), Ph.D., Wisconsin, D.Sc.
Rhode Island; G. E. Goertz (Associate Dean), Ph.D., Kansas State.

Associate Professor:

J. L. Cunningham (Assistant Dean), Ph.D., Michigan State.

Assistant Professor:

V. S. Anagnost (Assistant Dean), M.S., Tennessee.

5060 Practicum (1-12) Field experience in selected organizations that focus on interdisciplinary solutions to multifaceted problems of society. Prereq: Consent of instructor. May be repeated. Maximum 12 hrs.

5100 International Studies (1-15) Course designed for students interested in international relations. Prereq: 12 hrs of 5000-level courses representing 2 areas of Home Economics.

5210 History and Philosophy of Home Economics (3) Historical development of home economics; survey of concepts and philosophy of component disciplines and analysis of current programs; emphasis on projection of future developments.

5220 Development of Community Services Programs (3) (Same as Agricultural Extension 5210.)

5230 Evaluation of Community Services Programs (3) Purposes of evaluation, clarification of objectives and procedures for determining progress.

5600 Home Economics in the Community (3) The role of home economists in the community and how interactions among professionals of all community resources can facilitate finding solutions for and/or solving problems of individuals, families and communities as related to the quality of life. Prereq: Agricultural Economics 4320 or Economics 5340 or Food Systems Administration 5140 or Research Methods 5100 or Child and Family Studies 5700 or consent of instructor.


5800 Problems in Community Services (1-3) Prereq: Consent of the professor in charge of investigation. 12 hrs and credit to be arranged. May be repeated. Maximum 9 hrs.

5900 Seminar in Human Resource Development (1-3) May be repeated. S/NC only.

6000 Doctoral Research and Dissertation

6110-20 Theoretical Issues in Human Resource Development (3, 3) Interdisciplinary approach to the development and use of human resources in the solution of family and consumer problems. Prereq: 12 hrs of 5000-level courses representing 2 areas of Home Economics.

6210 Professional Issues in Human Resource Development (3) Role and philosophy, and administrative procedures for human resource development. Prereq: 12 hrs of 5000-level courses representing 2 areas of Home Economics.

6310 Advanced Topics (3) Comprehensive individual study and group discussion of individual and family behavior, physiological de-
development and well-being, environmental factors, and economic and social well-being. Prereq: 6110. May be repeated.

6500 Methodological Issues in Home Economics (3) Advanced methodology in home economics, with particular attention to interdisciplinary research methods and issues. Prereq: 1 graduate-level course in Research Methodology or consent of instructor.

6900 Seminar (1-3) May be repeated. S/NC only.

Home Economics Education

Graduate study in Home Economics Education provides for an M.S. in Home Economics Education and opportunity for participation in the Ed.D. program in Vocational-Technical Education in the College of Education. (See page 58 for staff and course offerings.)

Textiles and Clothing

MAJORS       DEGREES
Textiles and Clothing M.S.
Home Economics Ph.D.

Professor: A. J. Treece (Head), Ph.D. Ohio State.

Associate Professor: J. M. Ford, Ph.D. Pennsylvania State; B. C. Goswami, Ph.D. Manchester (England); C. J. Noel, Ph.D. Notre Dame.

Assistant Professors: R. P. Downer, M.S. Tennessee; M. F. Miller, Ph.D. Pennsylvania State.

Lecturer: A. L. Bullock, B.S. Mississippi College.

4210 Elementary Textile Microscopy (3) Introduction to microscopic techniques as applied to the study of textile fibers and fabrics. Prereq: Textiles II; Textile Chemistry. 1 hr and 2 labs.

4240 Design Analysis II (3) Creative interpretation of design terminating in finished garments developed through the media of draping. 1 hr and 2 labs.

5000 Thesis

5110 Textile Testing and Methods of Research in Textiles (3) Physical and chemical testing. Research methods. 3 labs.

5120 Advanced Problems in Textiles and Clothing (3) Refresher course; emphasis on new developments in textiles. Aids in selecting fabrics, agencies aiding consumer, and individual problems which students have met in the textile field. 2 hrs and 1 lab.

5130 Advanced Tailoring (3) Comparison of hand tailoring and trade methods used in making suits, coats, or costumes. 3 labs.

5150 Principles of Design Analysis (3) Application of flat pattern theory to garment design incorporating relationships of fabric geometry, texture, hand, and surface ornamentation to design. Prereq: Consent of instructor. 1 hr and 2 labs.

5160 Review of Literature (3) Intensive survey and evaluation of recent literature; implications for further research.

5170 Social, Psychological and Economic Aspects of Clothing (3) Clothing as it relates to human behavior. Prereq: 6 hrs or equivalent from each of the following areas: Sociology, Psychology, Economics.
THE UNIVERSITY OF TENNESSEE
Space Institute

Intercollegiate Programs

Aviation Systems

MAJOR
Aviation Systems

DEGREE
M.S.

Professors:
B. H. Goethert, Ph.D. Berlin; E. C. Huebschmann, Ph.D. Texas; R. S. Sleeper, M.A. Harvard; M. A. Wright, Ph.D. Wales; J. M. Wu, Ph.D. California Institute of Technology; R. L. Young, Ph.D. Northwestern.

Associate Professor:
S. N. Chaudhuri, Ph.D. Indian Institute.

Assistant Professor:
S. J. Miley, Ph.D. Mississippi State.

The University of Tennessee Space Institute offers this program leading to the Master of Science with a major in Aviation Systems. The Aviation Systems program is designed for those who possess bachelor's degrees in engineering or science and who wish to study under a "systems philosophy" toward careers in research and development or administration in various phases pertinent to aviation. The program features 18 quarter hours major field credit in various aspects of aviation systems, six or more quarter hours credit in each of the areas of research, development and administration, and electives which permit further specialization in either area.

To qualify for admission to this program, the applicant must possess a bachelor's degree in engineering or science from a recognized institution, show evidence of ability to pursue and benefit from the program, and fulfill University of Tennessee Graduate School admission procedures and grade point standards. Subject matter prerequisite to the program includes basic knowledge of computer utilization as represented by Computer Science 3150 or equivalent, a background in accounting as represented by Accounting 5710 or equivalent basic accounting courses, a basic knowledge of economics as represented by Introductory Economics or equivalent.

Both thesis and non-thesis programs are available for fulfilling the requirements of the program. The thesis program is the usual program and involves satisfactory completion of the following minimum requirements:

1. Eighteen quarter-hour credits in the major field of Aviation Systems.

2. For the research and development area, six quarter hours in I.E. 5700 and I.E. 5710 and for the administration area, six quarter hours in Economics 5070 and Accounting 5810, for a total of 12 quarter hours.

3. Six quarter hours of electives selected from the major field, engineering and/or the areas in item 2.

4. Nine quarter hours in A.S. 5000, Thesis, hence demonstrating the ability to conduct and report on an independent investigation.


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

1. Eighteen quarter-hour credits in the major field of Aviation Systems.

2. For the research and development area, nine quarter hours in I.E. 5700, I.E. 5710, and I.E. 5720 and for the administration area, nine quarter hours in Economics 5070, Accounting 5810 and Finance 5510, for a total of 18 quarter hours.

3. Six quarter hours of electives in one of the areas in item 2.

4. Six quarter hours of electives in the major field, engineering and/or the areas of item 2.

5. Satisfactory completion of three quarter hours in A.S. 5100, Project in Aviation Systems.

6. Satisfactory completion of a comprehensive final written examination on all course work submitted for the degree and defense of the project course paper.

The thesis program involves 45 quarter-hour credits minimum while the non-thesis program involves 51 quarter-hour credits minimum.


Electives typical of those suitable for credit in the area of Aviation Systems, Research and Development Include: A.E. 5150-60-70; Computer Science 4410-20-30 and 5110-20; Industrial Engineering 4060, 4150, 4230, 5720, 5730, 6700, 6730; Mathematics 4220-30, 4510-20-30; Metallurgical Engineering 5810-20-30; and Statistics 3550.

Electives typical of those suitable for credit in the area of Aviation Systems, Administration Include: Accounting 5820; Business Law 5110; Economics 5080; Finance 5100; Industrial Management 5130; Marketing 5100; Transportation 5100, 5130, 5210-20, and 5910.

5000 Thesis

5070 Airports and the Community (3) Structure of airports and their communities. Technology and economics of cargo, baggage, ticket and passenger handling. Airport management, economics and logistics. Interfaces with the community, collection and distribution, demand requirement analyses, types of developments and their projections. Prereq: A.E. 5910.
Ecology

MAJOR

Ecology

J. Frank McCormick, Director, Ph.D. Emory

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

ADMISSION

Requirements for admission to this program are: (1) admission to the Graduate School; (2) at least 12 quarter hours of college chemistry, nine quarter hours of college mathematics, and four quarter hours of ecology at the upper division level. Candidates for the doctoral degree are expected to take the Graduate Record Examination.

Application forms for admission should be obtained from the Graduate School. Inquiries concerning the admission requirements should be addressed to the Director, Graduate Program in Ecology, 408 10th Street, University of Tennessee, Knoxville, Tennessee 37916.

ADVISORS

Advisors are selected from ecologists in several departments of the University who have competence in the area in which the student expects to work. Entering students should consult early with the Director of the program on the choice of a faculty advisor who will become the chairman of the student's faculty committee.

MASTER OF SCIENCE

The minimum 45 quarter hours of graduate credit shall include 18 hours of ecology courses (exclusive of thesis), of which six hours shall be in Ecology 5210-20-30 and at least eight additional hours in ecology courses numbered above 5100; nine hours of thesis in Ecology 5000, and 18 additional hours in ecology or supporting courses. To insure an interdepartmental program, the required minimum of 45 hours shall include no more than 18 hours of non-thesis courses from any one department of instruction.

The general requirements for this master's degree are listed on page 17. A minor in ecology shall include Ecology 5210-20-30 (six hours) and at least three additional hours in approved ecology courses.

DOCTOR OF PHILOSOPHY

The requirements for this degree are in general the same as those of the Graduate School with the following two exceptions: (1) each student's faculty committee shall consist of at least two members from the department in which the dissertation is being supervised and at least two from outside this department; (2) this doctoral program must include Ecology 5210-20-30 and a minimum of nine quarter hours of courses numbered above 5000. A student cannot enroll for dissertation until his research proposal has been discussed and approved by his doctoral committee.

Shared Faculty


ECOLOGY

5210-20 Experimental Flight Mechanics (3, 3)
5100 Project in Aviation Systems (3) In-depth study and formal report on an aviation systems topic, normally performed during the last quarter of work toward degree in non-thesis program. For Aviation Systems degree candidates only.

5210-20 Experimental Flight Mechanics (3, 3)
Consideration of flight mechanics with emphasis on experimental techniques. Special airworthiness approved laboratory allows active student participation in a series of experiments demonstrating the acquisition of flight test data. Tests will be conducted covering a broad range of aircraft performance, stability and control characteristics. In addition to the development of the hands-on aspects of the class experiments, test techniques, instrumentation, and data reduction methods will also be the subject of the series of lectures included in the course. 5210 emphasizes performance and 5220 emphasizes stability and control. Prereq: A.E. 4120.

5210-20 Experimental Flight Mechanics (3, 3)
5220 Flight Mechanics (3, 3)
5990 Cybernetics Seminar (3)
92 Intercollegiate Programs

Cybernetics and Bionics

Professors:
T. C. Helvey (Emeritus), D.Sc. H.C., University of the Atlantic*; R. S. Steeper, M.A. Harvard*

5110 General Systems and Cybernetics Fundamentals (3)
Systems theory, cybernetics, bionetics, and general systems are presented with a review of the theories of information, automatic and manual controls, and computers, which are necessary for the understanding of the main topics.

5120 Cybernetic Biophysics (3) Interdisciplinary and systems aspects of the mechanism of the human body are presented which include the topology, chemistry, physics, and mental functions. Course presents primarily the engineering aspects of man, useful elective of all engineering programs.

5130 Applied Cybernetics and Bionics (3)
Utilization of cybernetics and bionics for communication and control in large human systems and in man-to-man macromechanizations. Recommended for those having participated in 5110 and 5120; persons primarily interested in an overview of systems dynamics may take with the instructor's consent.

5140 Cybernetics of Human Behavior (3) Aspects of human behavior with emphasis upon open and closed feedback loop interactions with the environment. Special emphasis on cognition and mental functions, second order interactions in interpersonal communication. Recommended for engineers and persons interested in man-machine interactions.

5990 Cybernetics Seminar (3)
Ecology

5000 Thesis

5100 Special Problems in Ecology (1-3) Individual investigations in ecology. Prereq: May be repeated with consent of instructor. Maximum 3 hrs.

5210-20-30 Principles of Ecology (2, 2, 2) An interdisciplinary study of theories and problems in ecology. Comparisons between land, freshwater, and marine environments, including man's roles in the world's ecosystems. Must be taken in sequence. Prereq: 4 quarter hours of ecology at the upper division level.

5310 Ecology for Planners and Engineers (3) Ecological principles and the effects that man caused changes have on living organisms, including man. Lectures and field trips. Designed for students in the Graduate School of Planning and Environmental Engineering.

5320 Implementation of Environmental Policy (3) The goals and problems of environmental legislation, especially the National Environmental Policy Act; the purpose, preparation, and evaluation of environmental impact statements and similar multidisciplinary studies. Prereq: 5210 or 5310, or Environmental Law.

6000 Doctoral Research and Dissertation

6100 Special Topics in Ecology (3) Seminars on advanced topics and recent developments in ecology. Prereq: Consent of Instructor. May be repeated.

6110 Seminar in Animal Behavior (2)

6120 Seminar in Aquatic Ecology (2)

6130 Seminar in Physiological Ecology (2)

6140 Seminar in Community Ecology (2)

6150 Seminar in Radiation Ecology (2)

6160 Seminar in Systems Ecology (2)

Economics

4260 Economics of Resources (3)

Environmental Engineering

4700 Air Pollution-Air Resources Management (3)

Forestry

4005 Forest Ecosystems (3)

4450 Game Mammals (4)

4460 Game Birds (4)

5210 Seminar in Wildlife Conservation (3)

5220 Seminar in Forest Tree Biology (3)

5240 Seminar in Forest Genetics (3)

Geography

5610 Selected Topics in Climatology (4)

5620 Quaternary Problems (4)

Plant and Soil Science

4320 Soil Formations, Morphology, and Classification (4)

5240 Soil Productivity and Management (3)

5250 Pedology (4)

5810 Crop Climatology (4)

5820 Advanced Crop Physiology and Ecology (4)

Psychology

5750 Ethological Psychology (3)

Zoology and Entomology

4240 Animal Ecology (4)

4660-70 Limnology (4, 4)

5570 Animal Populations (3)

5850 Insect Autecology (4)

5860 Geographic Distribution of Animals (4)

5870 Insect Synecology (4)

**Industrial and Organizational Psychology**

MAJOR

Organizational Psychology M.S., Ph.D.

Committee:

J. M. Larsen, Jr. (Chairman); R. D. Arvey; E. E. Cureton (Emeritus); R. L. Dibbey; M. E. Gordon; E. D. Sundstrum; C. Travis; G. H. Whitlock.

For complete Faculty Listing, see Departments of Industrial Management and Psychology

The master's and doctoral programs are offered jointly by the Department of Psychology and the Department of Industrial and Personnel Management. They are designed to prepare students for personnel, managerial, and organizational research, for university teaching, and for consulting relationships with industry. The emphasis is upon applied research utilizing a thorough theoretical background, including classical and modern organization theory, organizational behavior, psychology, and industrial management. The programs are administered by a joint committee of the two departments, appointed by the Vice Chancellor for Graduate Studies and Research on recommendations from the two department heads.

It is intended that students entering the program will represent widely different undergraduate and graduate backgrounds including psychology, business administration, engineering, science, and liberal arts. The first year program provides the opportunity to take courses which will assist the student to attain a reasonable level of sophistication in areas of deficit (Psychology 5350-60-70).

ADMISSION PROCEDURE

Applicants for admission should request forms and materials from both the Graduate Office and the Chairman, Industrial and Organizational Psychology Program, 413 Stokely Center for Management Studies.

Two separate applications must be completed: one application for admission to the Graduate School and one application for admission to the Industrial and Organizational Psychology program. Deadline: For fall entrance, all materials should be received by the Vice Chancellor for Graduate Studies and Research no later than March 15 if you wish financial assistantship consideration.

Standards: At least nine quarter hours of college mathematics and one course in statistics are required. Ordinarily, an undergraduate grade-point average of 2.5 or above is required, with no evidence of special weakness in mathematics and physical sciences. Test scores of 500 or above also are necessary on the Graduate Management Admission Test, or on each section of the Aptitude portion of the GRE. The advanced section for Psychology is required.

PH.D. PROGRAM

I. Course Requirements

A. Minimum course requirements

1. I.M. or Psych. 5170, 5180, 5190 (Proseminar in Industrial and Organizational Psychology)

2. Statistics 5050-60-70 (Behavioral Statistics). Exemption by petition

3. Psych. 5070 (Academic Practicum)

4. Minimum of three 6000-level seminars to be selected from Psych. or I.M. 6250, 6260, 6270, and I.M. or Psych. 6380*

5. 36 hours of Psych. or I.M. 6000 (Doctoral Dissertation)

B. Recommended electives

1. For students who require preparation in statistics: Behavioral Statistics Sequence (Statistics Department)

2. For preparation for advanced section (81) G.R.E. Psych. Proseminar

3. For students who require preparation in psychometrics: Applied Psychometrics

4. For students who require preparation in management: I.M. 5110, 5120, 5230 (the latter is the same as Psych. 5450)

5. For students who wish to pursue special research interests aside from their dissertation: I.M. 5250, 5260, 5270 (Readings in Organizational Psychology) I.M., or Psych. 6900 (Supervised Field Research)

6. Courses available in areas related to Industrial and Organizational Psychology:


b. Through College of Liberal Arts: Psych. 6450, 6460, 6470 Industrial Sociology

II. Program Requirements

A. Attainment of a B average in the Proseminar in Industrial and Organizational Psychology.

B. Completion of a comprehensive examination in general psychology

* May be repeated for additional credit.

** Any student in the doctoral program may be required to prepare a Master's thesis by the Industrial and Organizational Psychology Committee. This policy will be implemented by the committee at such time as a review of the student's record suggests that additional data on his qualifications for pursuing a Ph.D. are required.
within no more than two years of entry. This examination covers the following specific areas of psychology:

- History and Systems
- Testing and Individual Differences
- Sensation, Perception, and Psychophysics
- Learning
- Motivation
- Social

C. Completion of a general preliminary examination in scientific methodology within no more than two years of entry. This examination covers the following specific areas:

- Statistics
- Psychometrics
- Experimental Design

D. Completion of a special preliminary examination in the area of the student's major research and professional interests. This examination must be attempted no later than nine months following completion of the general preliminary examination. This examination may be repeated once, normally no later than six months after the first attempt, at the discretion of the student's doctoral committee.

E. Completion of an oral examination following the preparation of a doctoral dissertation. This examination covers the field of the doctoral research and related topics, and must be passed at least two weeks prior to the awarding of the degree.

F. Maintenance of at least a 3.0 grade point average.

M.S. PROGRAM

I. Course Requirements

A. I.M. or Psych. 5170, 5180, 5190
- Proseminar in Industrial and Organizational Psychology

B. Statistics 5050, 60, 70 (Behavioral Statistics) and applied psychometrics, 3 hrs.

C. 18 hours of additional course work to be selected primarily from among the 5000-level course offerings in industrial Management and Psychology [e.g., I.M. 5110, 5120, 5230; Psych. 5080 (Current Topics in Applied Psychology)]

D. 9 hours of Psych. or I.M. 5000
- (Master's Thesis)

E. Recommended: Psychology
- Proseminar.

II. Program Requirements

The Ph.D. program requirements described above in sections II A, II B, and II F comprise the major requirements for a Master's degree. An oral examination covering the thesis and related topics must also be completed.

University Studies

(Non-Departmental)

University Studies deal with important contemporary topics which are sufficiently comprehensive to require the study and attention of students and faculty from more than one college. They are open to all qualified members of the university community.

4100 Energy Needs and our Environment (3)
- Not allowed for graduate credit for ecology majors.

Water Resources Development

Floyd C. Larson, Director,
- Water Resources Research Center

MAJOR DEGREE
- Water Resources Development M.S.

Specific requirements for admission to this program are a Bachelor's degree in law, engineering, or one of the physical or social sciences from an accredited college or university, and evidence of ability to do work of graduate quality, as ascertained by undergraduate records. Also considered will be work record, if any, and letters of recommendation. The general policies and requirements of the Graduate School apply to this program.

The degree of Master of Science requires 45 quarter hours of graduate studies, including nine hours of thesis work. The exact curriculum of each student is decided in consultation with his faculty committee, depending on his background and field of interest. If in his undergraduate work the student has, in the opinion of his faculty committee, sufficient training and education in one or more of the required courses, he may substitute other elective courses. Electives will consist of advanced work in the student's specialty or in a related field.

3410 Principles of Ground Water Geology (3)
- (Same as Geology 3410.)

3565 Introduction to Public Administrative Organization & Management (4)
- (Same as Political Science 3565.)

4110 Managerial Economics (3)
- (Same as Economics 4110.)

4810 Water Law (3)
- (Same as Environmental Engr. 4810.)

5000 Thesis

5130 Planning Research Methods I (3)
- (Same as Planning 5130.)

5160 Planning and Utilities (3)
- (Same as Environmental Engr. 5160 and Planning 5160.)

5200 Water Resources Systems (3)
- (Same as Environmental Engr. 5200.)

5330 Descriptive Hydrology (3)
- (Same as Environmental Engr. 5330.)

5340 Hydrology of Agricultural and Forest Lands (3)
- (Same as Agricultural Engineering 5340.)

5410-20-30 Interdisciplinary Seminars (3, 3, 3)
- Problems relating to comprehensive water resource development including flood management, hydroelectric power, navigation, recreation, alternatives in water resource planning,
College of Liberal Arts

Alvin H. Nielsen, Dean
Charles W. Keenan, Associate Dean
Boyd L. Daniels, Assistant Dean for
Student Academic Affairs
Charles O. Jackson, Asst. Dean for
Curriculum & Instruction

The College of Liberal Arts offers
programs leading to eight advanced
degrees*. See page 9 for degrees
and majors.

Departments of
Instruction

Numbers in parentheses following the
course titles indicate quarter hours
credit offered.

Anthropology

**MAJOR**

DEGREE

Anthropology

M.A., Ph.D.

Professors:

W. M. Bass (Head), Ph.D. Pennsylvania;
A. K. Guthe, Ph.D. Michigan; P. W. Parmalee,
Ph.D. Texas A. & M.

Associate Professors:

C. H. Faulkner, Ph.D. Indiana; I. E. Harrison,
Ph.D. Syracuse; R. L. Jantz, Ph.D. Kansas;
H. M. Lindquist, Ph.D. Kansas;
M. C. R. McCullough, Ph.D. Pennsylvania.

Assistant Professors:

A. M. Henderson, Ph.D. Colorado;
F. H. Smith, Ph.D. Michigan.

**MASTER'S PROGRAM**

The formal requirements for the Master's
degree include:

1. A minimum of three quarters of
   residence at the University of
   Tennessee.

2. A minimum of 45 quarter hours for
   graduate credit, including prepara-
   tion of thesis. Thirty-six of these 45
   hours must be in anthropology, nine
   hours may be taken in closely related
disciplines (at least one-half of the
   courses must be at the 500 level.).

3. Satisfactory completion of the
   Graduate Evaluation at the end of
   the first year.

4. A thesis. In addition to the two (2)
copies required by the Graduate
School, one bound copy of the thesis
is to be presented to the Department
and one bound copy to the student's
thesis advisor.

3070 Genetics and Society (3) (Same as
Botany 3070).

3410 Principles of Cultural Anthropology (3)
Basic concepts and objectives in the study of
culture. The range of cultural phenomena
and methodologies approaches to its study. Prereq: Human Cul-
ture recommended.

3440 Religion of Primitive Peoples (3) The
religions of non-literate peoples. The place of
religion in their social and cultural systems.
Prereq: Human Culture recommended. (Same
as Religious Studies 3440.)

3450 Community Studies in Complex Culture
(3) Review of cross cultural comparative urban
and village communities and methodologies
used in community studies. Prereq: Human Culture
recommended.

3510 Peoples and Cultures of Mainland Asia
(3) Ethnographic survey of the indigenous cul-
tures of mainland Asia. Cultural diversity and
human ecology in areal perspective. Prereq:
Human Culture recommended.

3530 Peoples and Cultures of Africa (3)
Ethnographic survey of the aboriginal cul-
tures of sub-Saharan Africa. Cultural diversity
and human ecology in areal perspective. Pre-
req: Human Culture recommended.

3550 North American Indian (3) An ethnog-
graphic survey of the cultures of the Arctic,
Southwest, Plains and Eastern Areas. Emphasis
on the cultural differences of peoples oc-
cupying these areas during the pre-colonial
period. Prereq: Human Culture recommended.

3555 Cherokee Ethno History (3) Survey of
socio-political aspects of internal affairs and
external relationships from first European con-
tact to present. Emphasis on 18th and 19th
centuries.

3610 Archaeology of United States and
Canada (3) Survey of prehistoric peoples north
of Mexico from initial occupation to European
contact. Prereq: Prehistoric Archaeology
recommended.

3620 European Prehistory I (3) Cultural de-
velopments during the Paleolithic, Mesolithic,
and Neolithic. Prereq: Prehistoric Archaeology
recommended.

3630 European Prehistory II (3) Cultural de-
velopments during the Metal Ages. From the
close of the Neolithic through the Iron Age.
Prereq: Prehistoric Archaeology recommended.
3820 and 3830 should be taken in sequence.

3640 Ancient Civilization of Mesoamerica (3)
Introduction to the archaeology of areas of ad-
vanced Indian culture in Mexico and Central
America beginning with the earliest cultures
and proceeding to contact with Europeans.
Prereq: Human Culture recommended.

3710 European Folk Cultures (3) Traditional
aspects of European life, as expressed in techn-
ology, beliefs, art, and folklore, under chang-
ing historical and socio-economic conditions.

3800 Language and Culture (3) Relationship
between linguistic categories and patterns of
culture. Knowledge of linguistics not required.
Prereq: Human Culture recommended.

3811 Introduction to Museology (3) (Same as
Art 3811).

3900 Human Osteology (4) Intensive examina-
tion of the human skeleton. Prereq: Human
Origins and consent of instructor. 3 hrs and
1 lab.

3920 Principles of Physical Anthropology (3)
Survey of materials and methods in physical
anthropology. Prereq: Human Origins recom-
manded.

3930 The Biology of Races of Man (3) Proc-
esses of racial differentiation; criteria of sig-
nificant differences among existing stocks; in-
fluence of biology and culture in race forma-
tion; analysis of studies concerning blood
groups, race mixture, constitution, growth and

* M.A., M.A.C.T., M.F.A., M.Math., M.Mus., M.P.A.,
  M.S., Ph.D.
96 College of Liberal Arts


3950 Human Identification (3) Introduction to techniques in the identification of human skeletal material in Forensic Medicine.

4200 Contemporary North American Indian (3) Survey of Indian cultures from initial Euro-American contact to present; emphasis on culture change, U.S. Government Indian policy, reservation life; contemporary Southeastern Indian social and cultural problems. Prereq: Human Culture or consent of instructor.

4210 Ethnographic Research Techniques (3) Methods of collecting, organizing, and utilizing data. Prereq: Consent of instructor.

4240 Applied Cultural Anthropology (3) Applications of anthropological theory, methods and findings in programs of community and national development, public health, international aid, and military assistance. Examination of the roles of anthropologists, questions of values and ethics in intervention schemes, and of the organization of planned changes in applied programs. Intensive analysis of selected case studies. Prereq: Human Culture or consent of instructor.

4250 Medical Anthropology: Lecture (3) A survey of medical anthropology. Emphasis is on Western and non-Western cultural aspects of health, disease, treatment, death, and related concepts and descriptions of anthropological fieldwork.

4259 Medical Anthropology: Laboratory (3) Fieldwork in medical anthropology. Emphasis is on cultural aspects of health, disease, and death in industrial society, and the folk medicine systems which co-exist with Western, technical medicine. Prereq or coreq: 4250.

4300 Readings in Anthropology (1-9) Intensive reading, problem oriented. Prereq: Consent of instructor.

4340 Field Work in Archaeology (3-9) Practicum work surveying, excavating, processing, and analyzing of data; intensive reading. Prereq: 3 quarters of Introductory Anthropology and consent of instructor. May be repeated. Maximum 9 hrs.

4350 Field Work in Cultural Anthropology (3-9) A practicum devoted to fieldwork methods, ethnographic fieldwork reporting, survey and interview techniques, and the devising and carrying out of fieldwork projects. Prereq: 3 quarters of Introductory Anthropology and consent of instructor. May be repeated. Maximum 9 hrs.

4360 Field Work in Physical Anthropology (3-9) Practicum in the collection and analysis of human biological data. May include either skeletal or living populations. Prereq: 3 quarters of introductory Anthropology and consent of instructor. May be repeated. Maximum 9 hrs.

4410 Non-Western Education: Anthropological Approaches (3) Analysis of problems resulting from application of Western models of education in developing societies and in aboriginal communities within industrialized societies (e.g. American Indians).

4420 Dynamics of Culture (3) Culture change; innovation, diffusion and acculturation; cultural contacts. Prereq: Human Culture or consent of instructor.

4430 Personality and Culture (3) Analysis of relations among individual, society, and culture. Application of psychological techniques in cross-cultural social analysis and their influence on group behavior. Prereq: Human Culture or consent of instructor.

4440 Urban Anthropology (3) Survey of theoretical and methodological issues anthropologists encounter researching cross-cultural urban settlements. Focus is on anthropological perspective and urban problems and planning. Prereq: 3450 or consent of instructor.

4480 Current Trends in Anthropology (3) An analytical intensive seminar in recent developments in the current debates, research directions, theories, fieldwork methods, and general assumptions of the four subfields of anthropology: archaeology, physical anthropology, linguistics, and cultural anthropology.

4490 Cross-Cultural Survey of Sex Roles and Behavior (3) Examination of sex roles and sex behavior from cross-cultural and diachronic viewpoints. Discussion of scattered studies together and attempts to arrive at conclusions on questions as how sex roles are learned, the parameters of acceptable sexual behavior and degrees of tolerance for sexual deviation in various cultures.

4500 Peoples of China I: Chinese Society Before 1839 (3) An anthropological survey of Chinese society and culture during the pre-Shang, dynastic and early Western contact periods. Prereq: Human Cultures or consent of instructor. Recommended: 3510 or an East Asian course.

4510 Peoples of China II: Chinese Society After 1839 (3) An anthropological survey of Chinese society and culture in the period of intense Western contact, rejection of the West, and development of modern Chinese society and culture. Prereq: Human Culture or consent of instructor. Recommended: 4500 or an East Asian course.

4550 Indians of the Southeastern United States (3) Survey of Southeastern Indian cultures; emphasis on aboriginal adjustment to environment; lifeways of Southeastern American groups prior to Euro-American contact. Prereq: Human Cultures, 3540, or consent of instructor.

4560 Cherokee Ethnology (3) Intensive survey of ideology and material aspects of Cherokee culture existing at time of first European contact.

4570 Peoples of Southeast Asia (3) Survey of representative ethnic groups and indigenous cultures of mainland and island Southeast Asia. Problems of contact and comparison to Euro-American context. Prereq: Human Culture, or consent of instructor, or an East Asian course.

4580 Asians in the Americas Since 1800: Anthropological Perspectives (3) Character, factorization and multi-directional adaptations to North, Central and South America. Assimilation pattern and enclave communities are major topics. Major focus is on United States.

4590 Peoples of Japan (3) An analysis of the cultural diversity and unity of the people of Japan. Prereq: Human Cultures or consent of instructor, recommended 3510 or an East Asian course.

4600 Method and Theory in American Archaeology (3) The historical development of New World archaeology with emphasis on theory and field techniques. Prereq: Prehistoric Archaeology or consent of instructor.

4610 African Prehistory (3) Survey of cultural history in Africa, south of the Sahara, from earliest evidence of human activity to time of European contact. Prereq: Prehistoric Archaeology or consent of instructor.

4640 Zooarchaeology (3) Basic osteological studies of various parts of the skeleton of native animals and their role in the derivation of cultural faunas. Prereq: 9 hours of introductory anthropology and consent of instructor. May be repeated. Maximum 9 hrs.

4650 Archaeology of Southeastern United States (3) Intensive study of the prehistoric American Indian. Special emphasis on Tennesse prehistory. Prereq: 3610 or consent of instructor.

4740 Southern Appalachian Folk Culture (4) Research-oriented course dealing with wide range of traditional culture in Southern Appalachia: settlement patterns, folk housing, economics, traditional handicrafts, folklore, song, dance, and oral traditions and customs. Prereq: Consent of instructor. May be repeated.

4870 Cherokee Language (3) Linguistic survey of structure of the Cherokee language.

4930 Physical Growth and Constitution (3) Comparative growth patterns throughout the life cycle of man, skeletal and dental maturity; sex differences in growth; human constitutional types. Prereq: First quarter general anthropology. Strongly recommended: General Genetics or consent of instructor.

4950 Primate Studies (3) Survey of field and laboratory investigations of comparative anatomy and non-human primate behavior. Prereq: Human Origins or consent of instructor.

4960 Primate Paleontology (3) Survey of primate fossils and their relationship to human phylogeny. Emphasis on Pleistocene and more recent Hominid forms and the factors which shaped the evolution of modern man. Prereq: 3 quarters of Introductory Anthropology. Recommended: 4950 and Zool 4380.

5000 Thesis

5010 Graduate Research (1-9) Independent investigation of special problems in anthropology.

5100 Seminar in Cultural Anthropology (3-9)

5101 Foreign Study (1-12) See page 137.

5102 Off-Campus Study (1-12) See page 137.

5103 Independent Study (1-12) See page 138.

5140 Seminar in Zooarchaeology (3) Approaches to the analysis and interpretation of archaeological faunas. Emphasis on identification, analysis and discussion of major faunal studies, methods of identification, methods of presenting faunal data. May be repeated. Maximum 6 hrs.

5149 Laboratory Studies of the Vertebrate Skeleton: Examination and Interpretation of Skeletal remains of the major groups of fish, amphibians, reptiles, birds, mammals. Oriented toward identification and classification of derived faunas. May be repeated. Maximum 8 hrs.

5160 Seminar in Archaeology (3-9) Theoretical and practical issues central to contemporary archaeology. Prereq: Permission of instructor. May be repeated. Maximum 9 hrs.

5210 Community Anthropology: The Local Community (3) Courses dealing with practical issues, researcher models and research methods on the local community. Prereq: Consent of instructor.

5340 Fieldwork in Archaeology (3-9) Practicum work surveying, excavating, processing, and analyzing of data; intensive reading. Prereq: 9 hours of introductory anthropology and consent of instructor. May be repeated. Maximum 9 hrs.

5400 History of Anthropological Theory (3) Review of the contributions of the major influential anthropologists. Prereq: Consent of instructor.

5440 Peasant Societies (3) Critical analysis of existing literature and theories regarding rural urban polarities, interactions, and different cultural manifestations of agricultural populations. Prereq: Consent of instructor.

5450 Comparative Social Organization (3) Social structure in non-literate societies. Kin-
ship, age, sex, locality, and other factors in determining relations between individuals and groups. Prereq: At least one area course.

5460 Quantitative Methods in Anthropology (3) Application of quantitative methods to anthropological data. Emphasis on correlation and derivative procedures, distance analysis, discriminant analysis, and implementation of computer routines. Prereq: Statistics and probability or equivalent.

5510 Seminar in Ethnology of Western North America (3) Native North American culture types west of the Rockies; selected social systems, economics, technologies, and environmental factors. Prereq: 3540 or 4550 or consent of instructor.

5600 Theory in Archaeology (3) Review of development of archaeological theory. Coverage up to and including recent systems approaches.

5610 Problems in North American Archaeology (3) Graduate seminar designed to explore specific research problems in North American archaeology. Research topics on prehistoric ecology and settlement patterns in North America. Prereq: Consent of instructor. May be repeated once. (Same as Classics 5820.)

5670 Seminar on Aboriginal Lithic Resources (3) Analysis of techniques employed in production of prehistoric stone industries; raw materials employed; resultant implements, their morphology and functions; and typological concepts utilized in archaeological analysis. Prereq: Consent of instructor.

5680 Seminar in Prehistoric Lithic Technology (3) Analysis of techniques employed in production of prehistoric stone industries; raw materials employed; resultant implements, their morphology and functions; and typological concepts utilized in archaeological analysis. Special emphasis on: legislation, contracts, responsibilities, and certification; agencies and policies; project design, administration, and logistics; standards of field work, analysis and publication; archaeology and the public; conservation archaeology as a career. May be repeated. Maximum 6 hrs.

5690 Human Variation (3) Nature of human biological variation with emphasis on micro-evolutionary processes responsible for establishing and maintaining variation and relationships of population structure. Prereq: 3903 or consent of instructor.

5700 Theory in Folk Culture Studies (3) Graduate seminar analyzing major theoretical viewpoints of European and American folklore and folklore studies from inception to the present.

5710 Problems in Folk Culture Studies (3) Topical seminar dealing with selected problems and aspects of traditional behavior in European and American culture. Prereq: Consent of instructor. May be repeated. Maximum 6 hrs.

5710 Measurement of Man (3) A survey of the techniques of measuring and describing skeletal material and the human subject with emphasis on the practical applications to growth, nutrition, and human engineering. Prereq: Consent of instructor.

5920 Advanced Physical Anthropology (3) An intensive investigation of the theory and problems in physical anthropology.

5930 The Human Skeleton in Forensic Medicine (3) The application of physical anthropology in human identification. Determination of age, race and sex of the skeleton and preparation of reports for legal routines. Prereq: 3900.

5940 Skeletal Biology of Early Human Populations (3) An intensive treatment of practical and theoretical approaches to analysis of prehistoric human skeletal populations. Demonstrates in statistical, pathologic, and measures of biological relationships will be covered as they relate to the population as an adaptive unit. Prereq: 3900.

5945 Comparative Primate Anatomy (4) A laboratory-oriented course dealing with the functional anatomy of the primates. Particular emphasis will be placed on the musculo-skeletal system and the evolution of various primate adaptive patterns. Prereq: Osteology and one dissection course in zoology.

5950 Paleopathology (4) Identification and descriptive analysis of pathological conditions affecting the human skeleton. Roentgenological, descriptive analysis of pathological conditions of skeletal material. Lecture and laboratory. Prereq: 3900 and/or consent of instructor.

5960 Dermatoglyphics (3) Methods of dermatoglyphic analysis. Genetics and population variation of various dermatoglyphic elements; forensic applications; relationships to various genetic and chromosomal abnormalities. Prereq: Consent of instructor.

5970 Emergence and Early Evolution of Man (3) A detailed study of the ancestry and evolutionary significance of the Australopithecines. Prereq: 4970 or consent of instructor.

5980 Neanderthal Man and Human Evolution (3) An in-depth consideration of the morphological, distribution and evolutionary relationships of the Neanderthals. Prereq: 4970 or consent of instructor.

5990 Human Variation (3) Human biological variation with emphasis on micro-evolutionary processes responsible for establishing and maintaining variation and relationships of population structure. Prereq: 3903 or consent of instructor.

6000 Doctoral Research and Dissertation (5011-21-31) This seminar is offered each quarter primarily for doctoral candidates.

6040 Seminar in Art History (3) This seminar examines the existing literature on art reference, systems, and especially focuses upon synthesis of those data.

6070 Seminar in Human Paleontology (3) Prereq: 4970 and consent of instructor.

The thesis is a critical essay relevant to the field of concentration. The M.A. thesis may not be used to fulfill the project in lieu of thesis requirements for the M.F.A. A graduate exhibition is required. Final examination is oral.

MASTER OF FINE ARTS

The Master of Fine Arts is the terminal degree in studio art. Residence of at least five quarters beyond the baccalaureate degree is required.

Curriculum:

Projects in Lieu of Thesis

- Art History (5011-21-31)
- Art History (5011-21-31)
- Art History (5011-21-31)
- Art History (5011-21-31)
- Art History (5011-21-31)

Major areas consist of painting, communication design, printmaking, and sculpture. The candidate must complete a coherent body of work (project in lieu of thesis). A graduate exhibit is required. Final examinations are oral.

List of graduate courses for M.A. and M.F.A. candidates:

- Projects in Lieu of Thesis (5011-21-31)
- Projects in Lieu of Thesis (5011-21-31)
- Projects in Lieu of Thesis (5011-21-31)
- Projects in Lieu of Thesis (5011-21-31)
- Projects in Lieu of Thesis (5011-21-31)

* Six to twelve hours to be decided by the student's committee on the basis of the under-graduate preparation. Any reduction from the 12 hours in Art History would be added to the basic 9 hours of Art electives.

** Art electives may be outside the departmental major area and may be any course offered by the University for graduate credit.
5210-20-30-40-50-60, Oil Painting (3, 3, 3, 3, 3)
5310-20-30-40-50-60, Watercolor Painting (3, 3, 3, 3, 3)
5410-20-30-40-50-60, Sculpture (3, 3, 3, 3, 3)
5510-20-30-40-50-60, Communications Design (3, 3, 3, 3, 3)
5610-20, Intaglio (3, 3, 3)
5611-21-31, Lithography (3, 3, 3)
5612-22-32, Serigraphy (3, 3, 3)
5770-80-90, Seminar in Art History (3, 3, 3)
5900 Seminar in Art Criticism (3)

GRADUATE MINOR IN THE HISTORY OF ART
A graduate minor in art history may be arranged with the consent of the student’s committee, the instructors involved, and the Graduate School. Prerequisite is an undergraduate art history minor, or its equivalent, and reading knowledge of French, German, or Italian, unless waived by the art history faculty.

Classification of Art Courses
A. Studio Art: 3516, 3517, 4015, 4115, 4215, 4315, 4415, 4515, 4525, 4534, 4545, 4561, 4616, 4617
B. Art History: 3705, 3715, 3716, 3725, 3726, 3723, 3735, 3736, 3745, 3755-56-57, 3765, 3775-76-77, 3811, 4855-56-57, 4875-76-77.

3516 Typography (4) Theories and techniques of typography and printing as a fine art medium. May be repeated. Maximum 12 hrs.
3517 Airbrush (4) Techniques and creative applications. May be repeated once.
3705 Northern European Painting: 1350-1600 (4) Painting and printmaking of the low countries, France, Germany, and England. Includes international style manuscripts, Van Eyck, Bosch, Dürer, Holbein, and Bruegel.
3715 Early Italian Renaissance Art: 1300-1500 (4) Painting, sculpture, and architecture. Includes Giotto, Masaccio, Donatello, Brunelleschi, Alberti, Bottichelli, and Leonardo.
3716 Late Italian Renaissance Art: 1500-1600 (4) Painting, sculpture, and architecture. Includes Leonardo, Raphael, Michelangelo, Bramante, Titian and the Manerists.
3725 History of Baroque and Rococo Art, I (4) Art and architecture of Italy, Spain, Portugal, and Latin America in Seventeenth and Eighteenth centuries. Emphasis on Caravaggio, Bernini, Borromini, El Greco, Velázquez, Zurburan, and Montañés, urban development of Rome, and artistic relations between Iberia and Latin America.
3735 History of Nineteenth Century Painting in Europe and America (4)
3736 History of Twentieth Century Painting in Europe and America (4)
3745 History of Modern Architecture in Europe and America (4)
3746 History of Modern Sculpture in Europe and America (4)
3755-56-57 Studies in Art History (4, 4, 4) Concentration in selected areas. Prereq: 9 hours of Art History or consent of instructor.
3765 History of American Art (4) Art from the Colonial Period to the present day.
3775-76-77 History of Oriental Art (4, 4, 4) Art of India and the Far East. 3775—Indian Arts; 3776—China; 3777—Japan.
3811 Introduction to Museology (3) Concepts, practices and historical development of museums of art, archaeology, anthropology and science. (Same as Anthropology 3811.)
4015 Individual Problems (4) May be repeated. Maximum 12 hrs. Prereq: Consent of instructor.
4115 Drawing IV (4) Advanced compositions, stressing figure. May be repeated. Maximum 12 hrs. Prereq: 12 hrs. of 3115.
4215 Painting IV (4) May be repeated. Maximum 12 hrs. Prereq: Consent of instructor.
4315 Watercolor IV (4) Advanced composition in transparent and opaque watercolor. May be repeated. Maximum 12 hrs. Prereq: Consent of instructor.
4415 Sculpture IV (4) May be repeated. Maximum 12 hrs.
4515 Visual Communication IV (4) Corporate design: introduction.
4545 Visual Communications Seminar II (4) Political, social, economic and moral problems of contemporary designer. Prereq: 4515.
4615 Intaglio IV (4) Color problems with intaglio lithography. May be repeated. Maximum 12 hrs.
4616 Lithography IV (4) Color problems in lithography. May be repeated. Maximum 12 hrs.
4617 Serigraphy IV (4) May be repeated. Maximum 12 hrs.
4855-56-57 Reading and Research in Art History (2, 2, 2) Prereq: 16 hrs. of Art History and consent of instructor.
4875-76-77 Studies in Oriental Art History (4, 4, 4) Concentration in selected areas.
5011-21-31 Exhibition in Lieu of Thesis (3, 3, 3)
5101 Foreign Study (1-12) See page 137.
5102 Off-Campus Study (1-12) See page 137.
5103 Independent Study (1-12) See page 138.
5110-20-30-40-50-60 Drawing and Composition (3, 3, 3, 3, 3, 3)
5210-20-30-40-50-60 Oil Painting (3, 3, 3, 3, 3, 3)
5310-20-30-40-50-60 Watercolor Painting (3, 3, 3, 3, 3)
5410-20-30-40-50-60 Sculpture (3, 3, 3, 3, 3)
5510-20-30-40-50-60 Communication Design (3, 3, 3, 3, 3)
5610-20-30 Intaglio (3, 3, 3) Individual problems with etching and engraving. May be repeated.
5611-21-31 Lithography (3, 3, 3) Individual problems with lithography. May be repeated.
5612-22-32 Serigraphy (3, 3, 3) Individual problems with silk screen. May be repeated.
5770 Seminar in Art History (3)
5855-56-57 Reading and Research in Art History (2, 2, 2)
5900 Seminar in Art Criticism (3) Theory and practice. Intended for majors in studio art.

Audiology and Speech Pathology

MAJORS

DEGREES
Audiology and Speech Pathology
M.S.B. Burchfield, Ph.D. Michigan State; W. M. Collins, Ph.D. Missouri; T. O. Davidson, M.A. Tennessee; C. J. Ferrell, M.A. Tennessee; T. Marquardt, Ph.D. Washington.

THE MASTER'S PROGRAM
A major is offered in audiology or in speech pathology. A minor is offered in each of the two areas when approved by the department.

The intent of each major program is to provide the student with the scholarly and professional skills necessary for functioning as an independent professional clinician in any clinical environment. Within this broad coverage of speech pathology or audiology, it is possible for a student to specialize to some extent. For example, in the M.A. in the Audiology program, a student may emphasize audiological assessment, aural habilitation—rehabilitation, medical or pediatric, or industrial audiology. Within the M.A. in the Speech Pathology program, a student may emphasize language disorders, cultural language differences, or speech disorders such as aphasia or stuttering. Students interested in specializing beyond the typical broad M.A. program should consult the department office or their advisor for lists of suggested courses, practica and independent studies.

Students majoring in the two areas are expected to complete the academic requirements for clinical certification from the American Speech and Hearing Association, including the required number of clock hours of clinical practicum. An exception to this rule needs approval of the Department Curriculum Committee. Enrollment in clinical practicum courses is required for all clinical practice experiences but the maximum number of practicum credit hours that may be counted toward the Master's degree is 15 quarter hours. If the undergraduate preparation does not include sufficient course work in speech pathology, audiology, psychology, and related fields, the student may be required to make up such deficiencies.

Students may elect either the thesis
program or the non-thesis option. Students in both programs are required to take 5110 or 5119. The Master's program with the thesis will include a minimum of 45 quarter hours of approved graduate credit, including nine quarter hours of 5000 credit in the preparation of an acceptable thesis representing original independent work, and a final oral examination. At least one-half of these total courses must be at the 5000 or 6000 level, no more than nine hours of which may be thesis courses. Students in the non-thesis option program must present a total of 48 quarter hours of approved graduate credit and pass a final written examination. A minimum of 24 quarter hours must be at the 5000 or 6000 level. The decision as to choice of the thesis or non-thesis program is normally made following completion of 5110 and a conference with the student's advisor.

THE DOCTORAL PROGRAM

The Ph.D. program in speech and hearing sciences seeks to develop individuals for research or college teaching careers in the field of speech pathology, audiology, or speech and hearing science. This degree program is research oriented, with primary emphasis upon developing the scientific and cognitive skills which allow individuals to identify and independently study important questions concerning the human act of oral and aural communication. Students will be expected to master the accumulated knowledge in the area of:

1. basic speech, hearing and language processes,
2. speech, hearing and language disorders,
3. related disciplines providing insight into human communication processes,
4. technical skills in instrumentation and experimental design which enable the student to investigate problems pertaining to speech and hearing processes.

The program will normally consist of two or more calendar years of graduate study beyond the Master's degree with the first year being devoted primarily to formal course work and the last year to full-time research culminating in the doctoral dissertation.

Specific programs of study will be determined by the student in consultation with his faculty committee. In addition to the general Graduate School requirements, specific requirements for the degree of Doctor of Philosophy in speech and hearing sciences will include:

1. Successful completion of course work in the study of one or more research tools, or other specific scientific methodological vehicle pertinent to the research interests of the candidate. The choice of research tool(s) is subject to departmental approval.
2. A minimum of nine quarter hours of graduate credit obtained in course work in a cognate field outside the Department of Audiology and Speech Pathology. These hours are in addition to those required in item 1 above.
3. Sufficient course work within the Department but outside the area of specialization to give a broad foundation and understanding.
4. A comprehensive examination to demonstrate a general knowledge of the bases of audiology, speech and language pathology, and speech and hearing science; and advanced knowledge of the specifics of his area of specialization.
5. Research and dissertation to give at least 36 hours of graduate credit (6000 level).
6. A final oral examination.

4040 Appraisal of Speech and Language Disorders (3) Diagnostic procedures for children and adults with speech and language problems. Concurrent enrollment in 4049 required for majors. (Same as Special Education 4040.)

4049 Lab in Appraisal of Speech and Language Disorders (1) Observation and practice with diagnostic tests. Concurrent enrollment required in 4040. (Same as Special Education 4049.)

4060 Speech Science II (3) Speech production; clinical applications of speech science research. 2 lectures and 1 2-hour lab per week. Prereq: Speech Science I.

4190-200 Speech Development of the Hearing Impaired (3, 3) (Same as Special Education 4190-200.)

4210-20 Language Development of the Hearing Impaired (3, 3) (Same as Special Education 4210-20.)

4250 Introduction to the Education and Psychology of the Deaf (3) (Same as Special Education 4250.)

4310 Stuttering (3) Modern interpretations of stuttering and methods of treatment. (Same as Special Education 4310.)

4320-30-40 Clinical Practice in Speech Pathology (1-6, 1-6, 1-6) Prereq: Intro. to Speech Pathology, Phonetics, Articulation Disorders, 4040, and consent of instructor. May be repeated. S/NC only. (Same as Special Education 4320-30-40.)

4400 Voice Disorders (3) Etiology, diagnosis and treatment of organic and functional voice disorders. Prereq: Intro. to Speech Path. and Speech Science II. (Same as Special Education 4400.)

4450-60-70 Clinical Practice in Audiology (1-6, 1-6, 1-6) Prereq: 4720, 4630, or 4940. S/NC only. (Same as Special Education 4450-60-70.)

4520 Speech Pathology (3) Independent study of special problems in speech pathology. Prereq: Consent of instructor.

4550 Problems in Speech Pathology (1-6) Prereq: Consent of instructor.

4560 Problems in Audiology (1-6) Prereq: Consent of instructor. May be repeated. Maximum 9 hrs.


4650 Speech and Language of the Culturally Different Child (3) Discussion of speech and language differences of children of various minority groups, of different ethnic and class membership and from different geographic regions; their causes, and their effects upon educational programs.

4710 Introduction to Audiology (3) The fundamental aspects of hearing, including a study of physics of sound, anatomy and physiology of the ear, etiology and rehabilitation of hearing loss, and the psychological ramifications of sensory loss. (Same as Special Education 4710.)

4720 Audiology (3) Assessment of auditory functions by pure tone and speech audiometric procedures. (Same as Special Education 4720.)

4730 Medical Audiology (3) Survey of medical aspects of audiology pertaining to pathologies encountered in medical environments, with emphasis on specific etiologies. Prereq: 4710.

4740 Pediatric Audiology (3) Survey of test techniques employed in measuring the hearing of small children. Prereq: 4710 and 4720.

4750 Noise in the Environment (3) Discussion of the extent to which the noise problem exists, introduction to methods of noise measurement, basic techniques in sound and vibration abatement, acoustical factors, and physiological concomitants in noise stimulation. A knowledge of acoustics is advisable.

4930 Aural Rehabilitation: Speechreading and Auditory Training (3) Development of a receptive language process and development of maximum use of residual hearing in the acoustically handicapped. (Same as Special Education 4930.)

4939 Laboratory in Aural Rehabilitation (1) (Same as Special Education 4939.)

4940 Advanced Aural Rehabilitation: Acoustic Training (3) Development of maximum use of residual hearing in the acoustically handicapped. (Same as Special Education 4940.)

5000 Thesis

5040 Advanced Clinical Practice in Audiology Study and Practice (1-6) Prereq: Consent of instructor. May be repeated. Maximum 12 hrs. S/NC only. (Same as Special Education 5040.)

5050 Practicum in Aural Habilitation and Rehabilitation (1-6) Prereq: Consent of instructor. May be repeated. Maximum 9 hrs. S/NC only.

5060 Anatomy and Physiology of Speech (3) Structure and function of the non-muscular system involved in breathing, phonation, resonance, and articulation. Prereq: Speech Science II.

5070 Anatomy and Physiology of Hearing (3) Structure of the human ear, pathology of hearing impairment, and psycho-acoustics of audition. Prereq: 4710.

5071 Physiological Acoustics (3) Techniques for electro-physiological measurement of auditory sensitivity, sound transmission by the ear, distortion in the ear, and the ear as an analytic mechanism. Prereq: 4710, 4720, Speech Science II, or approval of the instructor.

5100 Comparative Anatomy of the Peripheral Auditory Structures (3) Tutorial laboratory course in comparative anatomy of the temporal bone employing microscopic dissection techniques. Prereq: 5070 or consent of instructor.

5110 Introduction to Research in Speech and Hearing (3) Analysis of research techniques, application of statistical methods, and completion of a pilot research project.

5119 Instrumentation in Speech and Hearing (3) An instrumentation course involving the spectrum of laboratory equipment available in speech and hearing science. Upon
completion, the student should be able to select proper instrumentation for measuring the parameters of speech and hearing.

5200 Seminar on Stuttering (3) Current significant research in the problem of stuttering. Prereq: 4310 or consent of instructor.

5201 Aphasia (3) A historical review of aphasia literature including theories of brain functioning, aphasic classification and terminology, tests and rationales for testing, etiology, therapy and rehabilitation and prognosis for recovery. Prereq: 4380 or equivalent or consent of instructor.

5320-30-40 Advanced Clinical Practice in Speech Disorders (1-6, 1-6, 1-6) Prereq: Consent of instructor. May be repeated. Maximum 6 hrs.

5350-60-70 Advanced Clinical Practice in Speech Diagnosis (1-6, 1-6, 1-6) Prereq: 4040, 4340 or equivalent. 5370 may be repeated. Maximum 9 hrs. S/NC only.

5380 Cerebral Palsy (3) Study of cerebral palsy with emphasis on neurological foundations and speech and language training. Prereq: Articulation Disorders. (Same as Special Education 5380.)

5390 Cleft Palate (3) Etiology, diagnosis and clinical management of cleft palate speaking with emphasis on speech. Prereq: Articulation Disorders. (Same as Special Education 5390.)

5440 Hearing Aid Evaluation (3) Study of the procedures involved in assessing the benefits of amplification of sound for the acoustically handicapped. The pertinent research in the areas of evaluation methods, binaural vs. monaural prescription fitting, etc., will be reviewed. Prereq: 4720.

5450 Sound Measurement and Analysis in Hearing Conservation (3) Study of noise measuring systems and techniques, a survey of factors in military and industrial audiology, and study of the role of the audiologist in industry. Prereq: 4710 or consent of instructor.

5460 Differential Diagnosis of Auditory Disorders (3) Theory and practice of advanced pure tone and speech audiometry; instrumentation and interpretation of audiometric findings with special reference to differential diagnosis. Prereq: 4720.

5470 Impedance Measurement in Audiology (3) Theory and practice of clinical measurement of hearing with emphasis on impedance measurement in the clinical measurement of hearing. The course will include clinical evaluation and in use of several impedance measuring devices. Prereq: 4710, 4720, 3060 or consent of instructor.

5500 Seminar in Audiology (3) Study of significant research in various areas of audiology. Prereq: Consent of instructor. May be repeated. Maximum 12 hrs.

5503 Seminar in Advanced Audiological Procedures (3) Theoretical and practical considerations of audiological procedures used for differentiating normal from pathological versus retrocochlear auditory lesions, identifying central auditory lesions, and for identifying nonorganic hearing loss.

5520 Seminar in Speech Pathology (3) Special study of current significant research in speech pathology. Topics vary from quarter to quarter. Prereq: 12 hrs in Speech Pathology. May be repeated with consent of department. Maximum 12 hrs.

5540 Seminar in Language Pathology (3) Nature, etiology and treatment of retarded language development in children. Prereq: Articulation Disorders. (Same as Special Education 5540.)

5550 Special Problems in Speech Pathology (1-3) Prereq: Consent of instructor. May be repeated. Maximum 6 hrs.

5560 Independent Study in Speech Pathology (1-3) Prereq: Consent of instructor. May be repeated. Maximum 6 hrs.

5600 Independent Study in Audiology (1-6) Special reading, consulting, and research activities in the field of audiology. May be repeated. Maximum 8 hrs.

5610 Practicum: Language Pathology in Children (3) A combination seminar and/or practicum in the discussion and utilization of testing tools and analyses of habilitative philosophies, specialties and techniques. Prereq: Consent of instructor. May be repeated. Maximum 9 hrs.

5651 Seminar in Language Differences (3) Study of significant research relevant to language differences of culturally different children.

5790 Seminar in Psycholinguistic Concepts in Speech Pathology (3) Psycholinguistic concepts and information theory utilized in studying the normal acquisition of language and certain disorders of language. Prereq: Speech and Language Development, Psychology 3210 or equivalent. (Same as Psychology 5790.)

5950 The Verbo-tonal System (3) Theory, procedures and instrumentation of Verbo-tonal System in areas of habitation, rehabilitation, diagnosis, speech therapy, and foreign languages. Prereq: 4710. Recommended: 4930 and Phonetics.

6000 Doctoral Research and Dissertation

6010 Experimental Phonetics (3) Principles involved in acoustical and physiological analysis of speech production and perception. Prereq: 5119 or consent of instructor.


6060 Applied Anatomy and Physiology of Speech Mechanism (3) Dissection and related readings. Prereq: 5060 or equivalent.

6070 Experimental Techniques in Cochlear Physiology and Neurophysiology (3) Prereq: 5070 or equivalent.

6080 Seminar in Speech Science (3) Advanced study of experimental areas such as speech physiology, acoustic analysis, recognition, perception, and auditory learning, compensation and rehabilitation, communication theory, and psycholinguistic measurement of speech and language. Topics vary from quarter to quarter. Prereq: 6010 or consent of instructor. May be repeated. Maximum 9 hrs.

6090 Seminar in Hearing Science (3) Advanced study of various topics of the perception of the non-speech acoustic signal; detectability, pitch, loudness, differential threshold, adaptation, and fatigue. Prereq: 6020 or consent of instructor. May be repeated. Maximum 9 hrs.

6110 Experimental Design in Speech and Hearing (3) Analysis of experimental design in theses and related journals. Psychophysical methods for data acquisition, generation of experimental designs based on parametric and non-parametric statistics. Prereq: 5110 or equivalent and consent of instructor.

6117 Theories of Hearing (3) The physiological basis of the classical theories of hearing as related to sensitivity; loudness; pitch; and discrimination of acoustic stimuli. Prereq: 5070 or consent of instructor.

6500 Advanced Seminar in Audiology (3) Prereq: Consent of instructor. May be repeated.

6520 Advanced Seminar in Speech and Language (3) Topics vary from quarter to quarter but include advanced study of specific topics related to aberrations of voice, articulation, speaking time and rhythm, language development or use, and language symbolization. Prereq: Consent of instructor. May be repeated.

6550 Directed Research (1-6) Participation in ongoing or non-dissertation research. Prereq: Consent of instructor. May be repeated. Maximum 12 hrs.

6570 Directed Study in Speech Pathology (1-3) May be repeated. Maximum 9 hrs.

6580 Directed Study in Audiology (1-3) May be repeated. Maximum 9 hrs.

6590 Directed Study in Speech Science (1-3) May be repeated. Maximum 9 hrs.

6600 Directed Study in Hearing Science (1-3) May be repeated. Maximum 9 hrs.

Biochemistry

MAJOR

DEGREES

Biochemistry

M.S., Ph.D.

Professors:

J. W. Greenawalt (Head), Ph.D. Purdue;
J. E. Churchich, Ph.D. Sheffield (England);
K. J. Monty, Ph.D. Rochester;
T. P. Salo, Ph.D. Michigan; J. R. Totter,
Ph.D. Iowa State.

Associate Professor:

J. G. Joshi, Ph.D. Poona (India).

Assistant Professors:

R. H. Feinberg, Ph.D. California (Berkeley);
S. W. Hawkkinson, Ph.D. Chicago.

THE MASTER'S PROGRAM

Candidates usually should offer an undergraduate major in either biology or chemistry. Departmental requirements consist of the satisfactory completion of 45 credit hours of graduate work and the mastery of the subject matter of the following courses:

1. One year each of Introductory Organic Chemistry (i.e., Chemistry 3211-21-31* and 3219-29-39*), Inorganic Quantitative Analysis (i.e., one quarter Analytical Chemistry, plus Chemistry 3630 or 4210), and Physical Chemistry (i.e., Chemistry 3410-20-30, 4110 or Biochemistry 4210-20-30.)

2. A minimum of 12 quarter hours of approved biology courses beyond the introductory level.

3. Biochemistry 4110-20, 4119, and at least two of the following: Biochemistry 5110, 5120, 5130, 5220, 5230.

4. At least nine hours of advanced lectures or seminar courses from the following: Biochemistry 6110, 6120, 6130, 6210, 6220, 6230, 6310, 6320, 6330, 6410-20-30.

5. Between nine and 18 hours of on-going or non-dissertation research. Prereq: Consent of instructor. May be repeated.

6. A final comprehensive examination which will cover both the thesis endeavor and the subject matter of the course requirements.

THE DOCTORAL PROGRAM

An incoming student must present an undergraduate major in either biology or chemistry. Departmental requirements include the satisfactory completion of:

1. Introductory Organic Chemistry (i.e.,