work relating specifically to school planning is offered through the Department of Educational Administration and Supervision, while two-year graduate assistant-ship programs are under the administrative auspices of the Laboratory.

**Departments of Instruction**

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

**Art and Music Education**

*Charles H. Ball, Head*

**Art Education**

**MAJOR**

**DEGREE**

Art Education

**M.S.**

Professor:  
J. W. Robertson, Ed.D. Columbia.

Associate Professor:  
H. N. Hull, Ed.S. Peabody.

Assistant Professor:  
J. P. Watkins, M.S. Tennessee.

The Master of Science Degree in Art Education is offered for art teachers, supervisors, and art trained persons holding the baccalaureate degree. The program provides both thesis and non-thesis options. Moreover, it is possible to achieve Tennessee Certification in art while pursuing the Master's degree program.

The thesis option requires 45 quarter hours as follows:

1. Art Education 5310, 5320, and electives ........................................... 18 hrs
2. Education C & I 5710, and electives .................................................. 9 hrs
3. Minor (selected with committee) .......................................................... 9 hrs
4. Thesis (Art Education 5000) .............................................................. 9 hrs

The non-thesis option requires 45 quarter hours as follows:

1. Art Education 5210, 5310, 5320, and electives .................................. 21 hrs
2. Education C & I 5800, and electives ................................................... 9 hrs
3. Minor (selected with committee) .......................................................... 9 hrs
4. Electives .................................................................................................. 6 hrs

The thesis option requires satisfactory completion of an oral examination prior to awarding the degree, while the non-thesis option requires satisfactory completion of a final written examination. Both the oral and written exams are conducted by the student's Master's degree committee.

Not all courses in art education are offered regularly each quarter, so the student should plan his or her program carefully with a faculty advisor.

**3210 Art in the Secondary School Program (3) Program planning; materials and equipment; relation to other school experiences. Classroom observation. Prereq: 9 hrs art education. 1 hr and 2 labs.**

**3920 Clay in School Program (3) Exploring methods of hand-built forms, glazing and firing procedures. Prereq: Introduction to Art Education in the Schools. 1 hr and 2 labs.**

**3930 Textiles in School Program (3) Exploration of processes of weaving, stitching, batik, and silk screen. Prereq: Introduction to Art Education in the Schools. 1 hr and 2 labs.**

**4120 Designing of Teaching Aids for Art in School Program (3) Design and preparation of charts, exhibitions, slides, films, and other teaching aids for art grades one through twelve. Prereq: Introduction to Art Education in the Schools or consent of instructor. 1 hr and 2 labs.**

**4130 Three-Dimensional Design in School Program (3) Exploration of wood, wire, metal, plastics, and other sculptural materials. Prereq: Introduction to Art Education in the Schools or consent of instructor. 1 hr and 2 labs.**

**4150 Lettering, Posters, and Displays in the School Program (3) Design and layout; techniques and procedures. Prereq: Introduction to Art Education in the Schools or consent of instructor. 1 hr and 2 labs.**

**4160 Appreciation of the Arts in the School Program (3) Prereq: Introduction to Art Education in the Schools or consent of instructor. 1 hr and 2 labs.**

**4350-60-70 Problems in Art Teaching (3, 3, 3) Prereq: Consent of instructor.**

**5000 Thesis**

**5002 Non-Thesis Graduation Completion (3) Prereq: Introduction to Art Education in the Schools or consent of instructor. 1 hr and 2 labs.**

**5210 Organization, Administration, and Supervision of Art in the School Program (3)**

**5310 Art in Education (3) Historical background, current philosophy, theory, and trends; nature and function of aesthetic behavior in the visual arts; relationships to psychology, sociology, and anthropology.**

**5320 Program Development in Art Education (3) Objectives, organization, content selection, facilities, and equipment; supervision; evaluation; professional growth; leadership and community relationships; art for the special student.**

**5350 and Educational Psychology 4760 or equivalents.**

**5850-60-70 Problems in Art Education (3, 3, 3) Prereq: Consent of instructor.**

**Music Education**

**MAJOR**

**DEGREE**

Music Education

**M.S.**

Professors:  
C. H. Ball (Head), Ph.D. Peabody;  

Associate Professors:  

Assistant Professor:  
W. H. McDaniel, M.S. Tennessee.

Thesis and non-thesis programs lead to the Master of Science degree in music education. Prerequisite preparation: undergraduate degree or equivalent in music education.

All graduate students in music education must pass proficiency examinations in music theory and applied music.

Requirements for thesis program:

45 quarter hours including thesis (9 hrs), the music education major (18 hrs), minor areas in music (9 hrs), and professional education (9 hrs). Required courses: Music Education 5000, 5210, 5220, 5230, Education 5710.

Requirements for non-thesis option:

1. Minimum of 51 quarter hours of course work with a minimum of 26 hours of the 5000 level.

2. Evidence of ability to understand and interpret research through completion of:

   A. Educational Statistics 5610 or the equivalent.

   B. Music Education 5710.

   C. Satisfactory performance of research activities in required courses in music education listed below.

3. Curriculum design:

   With the exception of the required courses listed below, with approval of the student's advisor, courses may be selected as described more fully below. This provides the flexibility necessary for the student to pursue in some depth specialized interests and needs in the following areas of music teaching: Elementary; Secondary (Junior and Senior High); Vocals (Choral); Instrumental (Band and Orchestra); and Supervision.

   (1) A major: at least 27 quarter hours in music education.

   (2) A minor: at least 15 quarter hours in music.

   (3) 9 quarter hours in professional education, including Educational Statistics 5610 and Educational Psychology 4760 or equivalents and a three-hour elective.

   4. Specific course requirements:

      A. Music Education Foundation (15 quarter hours)

         (1) One seminar (3 hours)

         (2) 5210, Psychological Foundations of Music

      (3) 5240, Evaluation Procedure in Music Education

      (4) 5250, The Role of Music in Education

      (5) 5710, Research in Music Education

   B. Music

   Six quarter hours in applied music (piano; voice; a band or orchestra instrument; or theory and composition).

   C. Education (limited elective of 6 quarter hours)

Education 4760, Advanced Child Study; or 5050, Learning and Development in Children; 5320, Advanced Educational Psychology; or other appropriate course in educational psychology with three hours credit.

5. Electives (with approval of advisor):
52 College of Education

A. Music Education: 12 credit hours from courses numbered 5000.
B. Music: 9 credit hours from courses at the 3000-, 4000-, or 5000-levels. No courses required in the undergraduate curricula may be included.
C. Education: 3 credit hours, elected from other departments in Education.

6. Evaluation (in addition to routine examinations in courses):
   A. Written comprehensive examination in major and minor fields.
   B. The student shall select one of the evaluation procedures below (with approval of advisor and committee):
      (1) Oral examinations in major and minor fields.
      (2) A public recital in principal instrument, piano or voice.
   C. The presentation in public performance of an original musical composition(s) accepted by the committee as music suitable for performing groups.
   D. Plan, rehearse, and conduct a full public performance of music by junior or senior high school music groups. This shall be worked out as a long-term project under the supervision of the student's committee.

7. Student's Committee: A minimum of three faculty members: the advisor from music education; one member from music; one member from education.

4410 The Administration and Organization of Recreational Music Programs (3) Purpose of music in recreation; scope of activities, organizational procedures, resources, and coordination required in community music programs.

4441-42-43 Teaching Class Piano (1, 1, 1) For majors in music, music education, or elementary education. Prereq: Consent of Instructor.

4450 Music in Special Education (3) The role and application of classroom music activities in the educational and rehabilitation programs of atypical children. Study of the uses and values of specific activities with emotionally disturbed, brain-injured, speech defective, physically disabled, and mentally retarded children. For majors in Special Education. Prereq: Permission of Instructor. The degree program has two options. A thesis option requires a minimum of 45 hours, with 18 hours in the major field, 15 hours of electives, 3 hours of educational research, and 9 hours of thesis preparation. The non-thesis option requires a minimum of 51 hours, with 24 hours in the major field, 24 hours of electives, and 3 hours of research methods. For each option, 9 hours must be completed in the behavioral sciences. A minor may be developed from the hours allotted to electives. The thesis option requires satisfactory completion of a final oral examination and the non-thesis option requires satisfactory completion of a final written examination.

5500 Thesis

5502 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.

5510 Studies in Secondary School Music (3) Development of understandings regarding growth patterns and processes through music experiences; cultural and community influences on secondary school music; problems in the administration and teaching of music in the secondary school; and relationship of music with the humanities in the curriculum. Sequel to Teaching Music in Junior and Senior High Schools.

5520 Psychological Foundations of Music (2) Perception; function; aesthetics; talent, measurement; implications for teaching theory and practice. A review of classic and current experimental studies. Prereq: Consent of Instructor.

5220 The Administration and Supervision of School Music (3) A study primarily to improve- ment of the teacher-learning, child-learning process in music education. Problems of supervision, research, and in-service education, teacher preparation, and guidance leave care- ful consideration and study.

5230 Comparative Teaching Procedures in Music Education (3) Modern teaching theories and their implications.

5240 Evaluation Procedures in Music Educa- tion (3) Tests, measurements, and evaluation of music teaching procedures of students at all levels. Standard educational measurements and teacher-made tests applicable to music and specialized evaluative techniques for use in classroom situations. The uses of musical aptitude and achievement tests. Statistical measures applied to learning music. Prereq: General psychology, educational psychology and elementary statistics.

5250 The Role of Music in Education (3) An exploratory course designed for school personnel, other than music teachers, on the role of music in public education. No previous ex- perience in music required.


5270 Studies of Music for Children in the Primary Grades (3) Children's growth processes in music for Grades I-III, and musical experi- ences. For the major in music education and/or elementary education. Prereq: Teaching Music in the Intermediate and Upper Grades or Elementary School or consent of instructor.

5320 Advanced Choral Literature and Conducting (3) Reading, conducting, and interpreting vocal scores suitable for school, college, church, and community groups; emphasis on contemporary and standard major choral works. Prereq: Undergraduate degree with a major in music or music education; choral and instrumental conducting, choral methods and materials or equivalent.

5350-60-70 Special Problems in Music Educa- tion (3, 3, 3) Individual identification and study of current problems in music education at all levels of instruction and in the various specialized areas of the music curriculum. Prereq: 5510 or the equivalent and consent of instructor.

5410 Advanced Band Literature and Conduct- ing (3) Reading, conducting, and interpreting band scores suitable for school, college, and community bands; emphasis on contemporary and standard band literature. Prereq: Under- graduate degree with a major in music or music education; choral and instrumental conducting and teaching instrumental music or equivalent.

5510-20-30 The Talent Education Program of Shinichi Suzuki (2, 2, 2) Study of the psy- chological principles and literature utilized by Shinichi Suzuki in the Talent Education pro- gram in Japan. Prereq: Consent of instructor.

5710 Research in Music Education (3) Prereq: Consent of Instructor.

5810 Seminar (3) Music teaching in the pri- mary and intermediate grades. Survey of re- search, professional literature and development of bibliography. Laboratory activities. Projects. Prereq: Admission to M.S. program.

5820 Seminar (3) Music teaching in the vocal and general music areas of the junior high school curriculum. Survey of research, professional literature and development of bibli- ography. Laboratory activities. Projects. Prereq: Admission to M.S. program.

5830 Seminar (3) Music teaching in the instru- mental areas of the elementary, junior high, and senior high curricula. Survey of research, professional literature and development of bibliography. Laboratory activities. Projects. Prereq: Admission to M.S. program.

5840 Seminar (3) Music teaching in the vocal, theoretical, historical, and appreciation areas of the secondary school curriculum. Survey of research, professional literature and development of bibliography. Laboratory activities. Projects. Prereq: Admission to M.S. program.

Continuing and Higher Education

MAJOR

5000 Thesis

5002 Non-Thesis Graduation Completion (3) Required for the non-thesis student not other- wise registered during any quarter when such a student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.

5060 Adult Education: A General Survey (3) Surveys the historical development of the field, philosophies of adult education, agencies, pro- grams, current issues, and the literature of adult education.

5110 Seminar in College Teaching (3) Effec- tive college teaching; testing and measure- ment; recent research in college instruction; major problems and issues in higher education. Requirements of candidates for the MACET degree. S/NC only.

5110 Seminar in College Teaching (3) Effec- tive college teaching; testing and measure- ment; recent research in college instruction; major problems and issues in higher education. Requirements of candidates for the MACET degree. S/NC only.

5330 Theory and Research in Human Learn- ing (3) (Same as Ed. Psy. 5330.)

5360-70 Problems in Continuing and Higher Education (3, 3) Independent study of problems and special institutes.

5440 American Higher Education (3) Pur- poses, functions, organization, and programs.

5450 Instruction in Higher Education (3) Prob- lems, procedures, and techniques.
5460 Adult Development (3) Changes in characteristics of the adult over the life span and implications for adult education.

5510 Governance of Colleges and Universities (3) Study of the development, change, trends, process, and structure of collegiate governance.

5550 Fiscal Problems in Higher Education (3) A study of revenue sources and fiscal management major public and private colleges and universities.

5680 Program Planning in Continuing and Higher Education (3) Theory and method for planning adult education programs.

5860 The Community-Junior College (3) History and role of the two-year college, major functions, organization and administration, problems, and issues.

5995-65-75 Practicum in Continuing and Higher Education (3, 3, 3) Supervised practice in selected areas of instruction or administration of continuing or higher education programs.

5990-77 Seminar in Continuing and Higher Education (3, 3) Problems and issues confronting professional in the fields of adult or higher education.

6450 Community Education for Adults (3) Contemporary problems and opportunities of secondary school opportunities for adults.

See also course listings under the Department of Curriculum and Instruction, Educational Administration and Supervision, and Educational Psychology and Guidance.

**Curriculum and Instruction**

**MAJORS**

| Curriculum | M.S. |
| Curriculum and Instruction | Ed.S., Ed.D. |
| Elementary Education | M.S. |
| English Education | M.S. |
| Foreign Language Education | M.S. |
| Instructional Materials | M.S. |
| Mathematics Education | M.S. |
| Science Education | M.S. |
| Sociology Education | M.S. |

**DEGREES**

- **Professors:**
  - J. J. Bellion, Ed.D. California (Berkeley);
  - J. J. Alexander, Ed.D. Kentucky;
  - C. B. Allison, Ph.D. Ohio;
  - P. J. Burns, Ph.D. Iowa;
  - L. J. Chiles (Emeritus);
  - A. M. Missouri;
  - M. A. Christiansen, Ph.D. Kansas;
  - K. L. Carpenter, Ed.D. (Emeritus);
  - F. D. Georgia;
  - C. T. Cox, Ed.D. Peabody;
  - D. J. Dessart, Ph.D. Maryland;
  - H. Frandsen, Ph.D. Illinois;
  - L. O. Hasby, Ed.D. Columbia;
  - A. M. Johnston, Ph.D. Chicago;

- **Assistant Professors:**
  - L. C. Cagle, Ed.D. Georgia;
  - M. M. Donnelly, Ph.D. Illinois;
  - C. L. Fairlie, Ph.D. Kent State;
  - R. L. Hodge, Ph.D. Texas;
  - P. E. Huff, Ph.D. Ohio State;
  - A. M. Rutherford, Ed.D. Kansas;
  - S. J. Wynn, M.S. Tennessee.

- **Instructor:**

- **Lecturer:**

Graduate programs are designed to improve scholarship and educational competence in a number of areas leading to the Master of Science degree, the Specialist in Education degree in Curriculum and Instruction, or the Doctor of Education degree.

**MASTER'S PROGRAM**

For the Master of Science degree, thesis and non-thesis options are available in the following majors: curricular, elementary education, English education, foreign language education, instructional materials, mathematics education, science education, or social science education. The non-thesis option requires the completion of 51 quarter hours of course work.

**SPECIALIST PROGRAM**

The Educational Specialist degree program in the Department of Curriculum and Instruction will encompass concentrations in the following areas:

- **Curriculum**
  - Elementary education
  - Foreign language education

- **Instructional materials (media)**
  - Mathematics education
  - Science education
  - Social science education

The program includes a minimum of 90 quarter hours of graduate study. If the student has earned the Master's degree, a maximum of 45 hours of his Master's work may be credited to the 90 hour Ed.S. requirement. The program must also include the following:

1. A minimum of 12 hours taken in one of the eight areas listed above.
2. A minimum of 12 hours taken within the College of Education in areas other than the student's major area.
3. A minimum of 12 hours taken outside of the College of Education.
4. A minimum of nine hours earned through the writing of a thesis.

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

**DOCTORAL PROGRAM**

The doctoral major in Curriculum and Instruction may include emphasis upon the following fields: comparative education, curriculum, educational philosophy, educational research, elementary education, English education, foreign language education, mathematics education, science education, social science education.

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

4010 International Education: Europe and the Americas (3) Historical, philosophical, and sociological foundations; special reference to England, USSR, France, and Germany.

4110 Philosophies of Education in Cultural Perspective (3) Education in relation to the liberal, conservative, reactionary, and radical currents of thought in American culture.

4150 School Library Administration (3) Same as MLIS 4150.

4210 Curriculum in Elementary School Social Studies (3) Survey of current curricular approaches and trends in elementary school social studies. Prereq: Teaching experience or student teaching.

4215 Teaching Elementary School Science (3) Methods and materials used in teaching science in elementary school. Developmental and diagnostic/corrective programs. Not open to students with recent course or background in teaching elementary school science.

4216 Teaching Elementary School Mathematics (3) Methods and materials used in teaching mathematics in elementary school. Developmental and diagnostic/corrective programs. Not open to students with recent course or background in teaching elementary school mathematics.

4217 Teaching Elementary School Language Arts (3) Methods and materials used in teaching elementary school language arts. Development of functional relationships with other curriculum areas, diagnostic procedures, and corrective work. Not open to students with recent course or background in teaching elementary school language arts.

4250 Initiating the Activities Program (3) Prereq: Child Development. Methods of Teaching in the Elementary School.

4260 Philosophy of Education: Introductory Studies (3) Truth, knowledge, and valuation in relation to the work of the schools. Prereq: History and Philosophy of Education, Child Study or Educational Psychology; Adolescence, or equivalent.

4261 Educational Classics (3) Discussion of selected writings from Plato to Dewey.

4280 Diagnosis and Correction of Classroom Reading Problems (3) Prereq: Reading of the Elementary School or equivalent.

4300 Developmental Reading in the Secondary School (3)

4301 Teaching Developmental Reading (3) Methods and materials used in teaching reading in the elementary school. Includes development of functional relationships with other curriculum areas, diagnostic procedures and remedial work. Not open to students with recent course or background in the teaching of reading.

4340 The Junior High School and Middle Schools (3) To identify and analyze the dis-
54 College of Education

tinglish characteristics of the Junior High and Middle School curriculums.
4360-60-70 Problems in Teaching English (3, 3, 3)
4351-61-71 Problems in Teaching Mathematics (3, 3, 3)
4352-62-72 Problems in Teaching Social Studies (3, 3, 3)
4353-63-73 Problems in Teaching Science (3, 3, 3)
4354-64-74 Problems in Teaching Language Arts (3, 3, 3)
4355-65-75 Problems in Teaching General Curriculum (3, 3, 3)
4356-66-76 Problems in Instructional Materials (3, 3, 3)
4357-67-77 Problems in Teaching Foreign Languages (3, 3, 3)
4359-69-79 Problems in Teaching Conservation (3, 3, 3)
4360-90-400 Problems in the Improvement of Instruction (2, 2, 2) Special conferences, workshops, or in-service programs.
4381 Problems in Early Childhood Education (3) May be repeated. Maximum 9 hrs. 6 hrs can be taken concurrently.
4410 Educational Sociology (3) Emphasis on examination of the school as a social system. (Same as Sociology 4410.)
4450 Teaching in Kindergarten: Overview (3) Relationship of kindergarten to total elementary program; goals, historical settings and current developments.
4451 Teaching in Kindergarten: Program Development (3) Curriculum planning and organization; classroom management. Prereq: 4450 or permission of instructor.
4530 Home and School Relations (3) Study of need for and techniques which can develop closer relationship between the home and school at both elementary and secondary level.
4530 Current Educational Problems (3)
4654 Programs, Methods and Materials in Environmental and Science Education (3) Instructional materials, teaching methods, curricular programs and issues in environmental and science education.
4750 Audiovisual Methods and Techniques (3) Selection, operation, and use of equipment and materials. (Same as Lib. and Inf. Sci. 4750 and Voc-Tech. Ed. 4750.)
4840 Introduction to Data Processing in Education (3) Analysis of current activities in the field of Educational Data Processing. The emphasis is placed on curricular, administrative, and research opportunities in education, using modern electronic data processing methods and machines.
4860 Programmed Learning (3) Theories of learning as related to technology of programmed instruction; techniques and applications of programming. 2 hrs and 1 lab. Prereq: Psychology 3210, Educational Psychology 3730, or permission of Instructor. (Same as Psychology 4650.)
5000 Thesis
5002 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.
5040 Seminar in Elementary School Language Arts (3) Analysis of current curricular issues related to elementary school language arts education. Emphasis on individual student presentations, projects, and investigations. Prereq: At least one year of teaching experience (K-9), or consent of instructor.
5100 History of European Education (3) Ancient Greece to the development of national school systems.
5110 History of Education (3) Foundations for American education.
5140 Comparative Philosophies of Education (3) A study of the major philosophic schools of thought. Prereq: 4260 or equivalent.
5141 Pragmatism in Education (3) Consideration of the effects the American pragmatist tradition has had on educational theory and practice. Prereq: At least one course in history or philosophy of education.
5142 Existentialism in Education (3) An examination of the literature of existentialism as a source for reconciling intrinsic human diversity with a demand for social conformity in public education. Prereq: At least one course in history or philosophy of education.
5143 Supervised Readings in Philosophy or Education (3) Prereq: At least 9 hrs in history or philosophy of education.
5150-60-70 Seminar (1, 1, 1) Educational literature.
5180-90-200 Educational Specialist Research and Thesis (3, 3, 3)
5210 Seminar in International Education: Asia and Africa (3) Historical, philosophical, and sociological foundations; special reference to Japan, China, India, and Nigeria.
5211 Instructional Strategies in Elementary School Social Studies (3) Specific teaching methods and instructional procedures for organizing social studies learnings will be compared. Prereq: An undergraduate social studies course or equivalent.
5220 Supervised Readings in International Education (3) An examination of existing literature in any area of international education, with emphasis on historical, philosophical and sociological foundations. Prereq: Consent of instructor.
5230 Diagnosis and Remediation of Arithmetic Difficulties (3) Study of student's problems in learning arithmetic concepts with emphasis on tools and strategies for the diagnostic teaching of arithmetic. Prereq: 5280 or 5825, or consent of Instructor.
5240 Creative Thinking and Expression in the Elementary School (3) Designed to give students the opportunity to examine the development of creative potential across the academic curriculum of the elementary school. Prereq: Consent of instructor.
5290 Secondary School Instruction (3)
5270 The Elementary School Curriculum (3) Theoretical background and experimental approaches.
5280 The Teaching of Language Arts in the Elementary School (3) Trends, issues, and research in content and method for the language arts program, grades 1-8. Prereq: Undergraduate course in Teaching Language Arts in the Elementary School or consent of Instructor.
5281 Teaching Social Studies in the Elementary School (3) Recent trends, issues, and research findings. Credit cannot be received for both 5281 and 5970.
5282 Teaching Science in the Elementary School (3) Trends, issues, and research in content and method for the elementary program.
5283 Programs and Materials in Teaching Elementary Science (3) In-depth analysis of new and innovative science program materials, as well as instructional strategies inherent in teaching these materials. Prereq: 5282 or equivalent, or consent of instructor.
5284 Seminar in Teaching Elementary Science (3) Analysis of current curricular issues related to elementary science education. Emphasis on individual student presentations, projects, and investigations. Prereq: Teaching Science in the Elementary School or 5282 or equivalent, or consent of Instructor. At least one year teaching experience (K-9).
5290 The Teaching of Mathematics in the Elementary School (3) Trends, issues, and research in content and method for the mathematics program, grades 1-8. Prereq: Teaching Arithmetic in the Elementary School and 9 hrs Structure of the Number System or consent of instructor.
5291 Programs and Materials in Elementary School Language Arts (3) Examination of prospective special instructional aids associated with the language arts. Prereq: 5280 or equivalent, or consent of instructor.
5292 Seminar in Research and Theory in Teaching Mathematics in the Elementary School (3) Examination of current research and theory in the teaching of mathematics, and their application to the teaching of mathematics. Prereq: Teaching Arithmetic in the Elementary School or equivalent, consent of instructor, and one year of teaching experience.
5362 Psychology of Reading (3) Presents a deeper understanding of the reading act, a more accurate insight into the relationship between learning theory and reading and a greater knowledge of the role of reading in the child's overall intellectual development. Prereq: An undergraduate reading course or consent of instructor.
5364 Programs and Materials for Reading Instruction (3) Developing a rationale for the examination, selection, and use of materials in the reading program. Special emphasis on distinguishing between approaches and materials for teaching reading. Prereq: Teaching of Reading in the Elementary School or 4500 or consent of instructor.
5365 Trends and Issues in Teaching Reading (3) A critical analysis of new programs, materials, innovations, and developments in reading. Prereq: An undergraduate reading course in reading or consent of instructor.
5366 Teaching Reading to the Linguistically Different Learner (3) Language characteristics and special reading problems pertaining to the linguistically different learner. Prereq: Undergraduate reading course, 4300 or 4301 or consent of instructor.
5350 Curriculum Development and Evaluation (3)
5360-70 Curriculum Development in the Local School (3, 3)
5355 Mathematics Laboratories in Elementary School (K-8) (3) Designed for elementary school teachers dealing with activity oriented mathematics laboratory materials and pedagogical strategies. Theoretical considerations and development of curricular materials for the laboratory. Prereq: Consent of instructor.
5380 Diagnosis of Remedial Reading Problems (3) Prereq: 4260.
5381 Remediation of Remedial Reading Problems (3) Prereq: 5380 or consent of instructor.
5382 Developmental Reading Practicum (3) Diagnostic and teaching children having developmental and corrective reading needs. Prereq: 4280.
5383 Remedial Reading Practicum (3) Prereq: 5381.
5390 Organization and Administration of Reading Programs (3)
5410 The High School Curriculum (3) Theoretical background and experimental approaches.
5530 Curriculum Laboratory for High Schools (3) Study and production of syllabi, courses of study, source units, and other materials.
5580 Curriculum Planning and Development (3)
5610 Educational Statistics (3)
5620 Problems in Direction and Supervision of Student Teaching (3)
5640 Newer Trends in Elementary Education (3) Trends in classroom procedures, equipment, and materials of instruction; problems involving improvement of instruction.
5650-60 Curriculum Laboratory for Elementary Schools (3, 3) Study and production of syllabi, courses of study, source units, and other materials.
5670 Curriculum Laboratory for Early Childhood Education (3)
5691 Production and Use of Audiovisual Materials (3) Practical graphics, adapted to the needs of teachers. Producing and reproducing picture mounting, transparencies, slides, and lettering. Prereq: L.I.S. 4750 or equivalent. (Same as L.I.S. 5691.)
5710 Techniques of Research in Education (3) Study and application.
5720 Classroom Observation and Analysis (3) Classroom observation and analysis procedures; development of objective observation and analysis skills, examination of existing observation systems.
5800 Seminar in Cooperative Curriculum Research (3) Action research procedures and their application to programs.
5820 Seminar in the Teaching of Mathematics (3) Analysis of teaching strategies related to subject matter and learner problems. Student presentations initiate discussion sessions. Prereq: At least 1 yr teaching experience (Math grades 7-12) or consent of instructor.
5825 Teaching Mathematics in the Middle and Junior High School (3) Study and discussion of problems related to teaching mathematics in middle and junior high schools. Emphasis on using knowledge of structure of mathematical concepts as well as strategies, methods, and materials for teaching. Materials suitable for individualized instruction, mathematical laboratories, and independent study are considered. Opportunities for individual projects. Prereq: Teaching Arithmetic in Elementary Schools or Teaching of Math, Grades 7-12, or equivalent.
5830 Seminar in Mathematics Education (3) Current curricular issues. Emphasis on individual student projects and investigation.
5835 Teaching Mathematics in the Senior High School and Community/ Junior College (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 Education (3) Historical background, trends, and issues as basis for planning instruction, programs, materials, and techniques of teaching.
5842 Problems in Education: Early Childhood Education (3) May be repeated. Maximum of 9 hrs. Six hrs may be taken concurrently.
5843 Seminar in Early Childhood Education (3) Analysis of the history of 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) 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)
5859-69-79 Problems in Education: Conservational Science (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 speech and listening.
5909 Instructional Theory and Design (3) Course is designed for those individuals at the Masters and Doctoral levels who have interest in in-depth studies of the instructional process and its relationship to curriculum and learning.
5910-20-30 Problems in Lieu of Thesis (3, 3, 3)
5911 Directing the Forensic Program (4) (Same as Speech 5911.)
5912 Play Production in Secondary Schools (4) (Same as Theatre 5912.)
5913 Seminar in the Teaching of Science in Grades 7-12 (3) Emphasis on teaching science, testing and evaluation techniques, and professional guidelines for program planning in 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 areas 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/NC only.
6060 Advanced Study of Methodology in the Elementary School (3) (Continuation of 5640) Consideration will be given to recent and current literature in the field and to sound educational practices in relation to the teaching of children. Prereq: 5640 or consent of instructor.
6070 Advanced Seminar in International Education (3) Analysis of selected problems: poli-
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-relevant research from other fields. Prereq: An undergraduate course and one graduate course in social studies, or equivalent.

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

6400 The Dynamics of Educational Change (3) Causes of the lag between educational research and writing.

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: 5260 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.

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 and secondary school 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; evaluation of workshop approaches to curriculum education and instructional improvement.

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

6830 Studies in Mathematics Education (3) Reading and study related to historical trends and issues in mathematics education in the United States for the purpose of providing a broad perspective on current curricular problems andfuture trends. Prereq: 5303 or consent of instructor.

6850 Principles of Educational Leadership (3) Addressing the ethical, legal, and social issues of education in the United States.

6890 Seminar in Educational Policy (3) Seminar of some selected philosophical, ethical, and social issues in education. Prereq: At least 2 courses in history or philosophy of education.

6891 Seminar in the 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.
6220 Programs for the Professional Preparation of Educational Administrators and Supervisors (3)

6640 School Personnel Administration (3) Study of personnel administration functions, both for professional and supporting staff, in educational organizations. Topics will include recruitment, selection, placement, personnel policies, employee wage and salary administration, 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, personal policy development; collective bargaining; in education; and staff evaluation. May be repeated. Maximum 12 hours.

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

6550 State-Federal Relations in Education (3)

6650 Legal Foundations of Public Education (3)

6580 Seminar in Decision Making (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)

6990 Specialized Doctoral Seminar in Politics of Education (3) Seminar on political theories and practical policies that 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: 5290, 5810 or equivalent or consent of instructor.

6997 Specialized Seminar in Organization and Supervision (3)

6996 Specialized Seminar: School Plant (3)

6997 Specialized Seminar in Organization and Supervision (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)

College of Education

Educational Psychology and Guidance

MAJORS DEGREES

Degree

College Student Personnel Education, Psychology B.S.

Educational Psychology and Guidance Ed.D., M.S.

Guidance Ed.D., M.S.

Professors:


Associate Professors:


Assistant Professors:


Graduate programs (thesis or non-thesis 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, and attention to the 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.

4554-55-56 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 personality adjustment.

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

4750 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) Nature and sources of individual differences in behavioral characteristics, between ethnic, social-economic, sex, and other groups.

4910 Diagnostic and Corrective Teaching (3)

5000 Thesis

5062 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or facilities before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.
5400 Guidance and Pupil Personnel Services in Education (3) (Same as V.T.E. 5404.)

5500 Children and Adolescents (3) Mental, social, physical, and emotional growth, development, and learning of children and adolescents; prevention, identification, and remediation of learning problems.

5600 Group Approaches with Students (3) Knowledge and skills appropriate to functioning with groups in counseling; psychological and parent education.

5700 Seminar in Elementary School Guidance (3) Trends, role, function, and administration of guidance in the elementary school.

5999 Field Work in School Psychology (2) Supervision of on-the-job 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, sex, and culture in which various theories were developed and current theories and research focusing 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 Interpreting Published Articles: Statistics (3) Emphasis on descriptive and experimental research in educational psychology, guidance and counseling, and college student personnel. Prereq: Non-thesis option students only or consent of instructor.

5220 Interpreting Published Articles: Research Design (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.

5310 Field Work in School Psychology: Level I (2)

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

5330 Theory and Research in Human Learning (3) Influence upon school practice. Prereq: Consent of Instructor. (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 education. Related theorists such as Bruner and Ausubel.

5550 Student Personnel in Higher Education (3) Philosophy and scope.

5560 The College Student (3) Nature, characteristics, and needs.

5570 Case Studies in College Student Personnel (3) Prereq: 5550 or consent of instructor.

5720 Evaluation in Education (3) Techniques and instruments for identifying and appraising social values, the thinking processes, social adjustment, emotional needs, personal interests and problems.

5780 Career Development: Theoretical Foundations of Education (3) (Same as Psychology 5780.)

5785 Career Development: Program Development Implementation and Evaluation (3) A study of career development and pre-vocational programs and projects. K-adult with emphasis on their development, implementation and evaluation. Prereq: 5780 or equivalent, or consent of instructor.

5790 Career Development: Workshop (1-6) Primarily designed for in-service training of school personnel. Developments, programs, and problems and trends related to career development. May be repeated. Maximum 6 hrs.

5830 Student Appraisal (3) Gathering, interpreting, and using data for development of guidance programs and individual counseling. Prereq: Ed. Psych. or consent of instructor.

5840-49-59 Practicum in School Psychology II (2, 2, 2) (Same as Psychology 5840-49-59.) S/NC only.

5850-60-70 Problems in Educational Psychology and Guidance (1-6, 1-6, 1-6) May be repeated. S/NC only.

5880 Career Development: Occupational and Educational Resources (3) Gathering, interpreting, and using educational, social, occupational, and community information in the guidance program; sources, types of materials, and occupational filing plans. For use both in group and individual guidance programs.

5890 Counseling Theories and Techniques (3) Interviewing and counseling procedures; dynamic factors; interpretation of diagnostic materials. Prereq: 4130, 4640 or consent of instructor. (Same as Psychology 5890.)

5897 Pre-Practicum (3) Didactic experiences and counseling simulations in a learning laboratory. Coreq: 5890.

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

5940 Counseling Practicum (3) Supervised practice in counseling in elementary or secondary school guidance and/or student personnel work. Prereq: 5060 or (5340), 5890, 5897 or consent of instructor. May be repeated with permission of advisor. Maximum 6 hrs.

5945 Group Counseling Practicum (3) Supervised practice in group counseling with children and/or adults. May be repeated. Maximum 6 hrs with consent of department. Prereq: 5340, 5890, 5897, and 5940 and consent of instructor.

5950-60-70 Consultation in Human Development Settings (3, 3, 3) (Same as Psychology 5950-60-70.)

5958-59-69 Practicum in School Psychology II (2, 2, 2) S/NC only. (Same as Psychology 5958-59-69.)

5960 Organization and Administration of Counseling Programs (3) Basic principles, procedures, and policies. Prereq: 4130, 4640 or consent of instructor.

5990 Practicum in College Student Personnel (3) Prereq: 5550-60-70 or consent of instructor.

6000 Doctoral Research and Dissertation

6040 Seminar in Educational Psychology and Guidance Required 3 quarters.

6110 Application of Research Design in Educational Psychology and Guidance (3) Major types of research design and statistical analysis unique to educational psychology, counseling, and college student personnel. Although several types of designs are discussed, emphasis is on those designs that are "experimental" in nature. Prereq: 2 courses in statistics or consent of instructor.

6120 Application of Experimental Research Design in Educational Psychology and Guidance (3) Major types of experimental designs used by researchers in educational psychology, counseling, and college student personnel. Prereq: 6110 or equivalent course.

6319 Field Work in School Psychology: Level II (2) (Same as Psych. 6319.)

6550-60-70 Seminar in College Student Personnel (2, 2, 2) Contemporary issues in the area of college student personnel, college counseling, student development, etc. Prereq: Consent of instructor, admission to the doctoral program. S/NC only.

6810-20-30 Seminar in Advanced Educational Psychology (3, 3, 3) Practicum in School Psychology I (2, 2, 2) S/NC only. (Same as Psychology 6810-20-30.) May be taken during final year of doctoral program.

6850-60-70 Systems Approaches in Psychological Services II (3, 3, 3) (Same as Psychology 6850-60-70.)

6859-69-79 Practicum in School Psychology II (3, 3, 3) S/NC only. (Same as Psychology 6859-69-79.)

6750-60-70 Problems in Educational Psychology and Guidance (3, 3, 3) S/NC only.

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 in 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) Acceptance in doctoral program and consent of instructor.

6950 Counseling Supervision (3) May be repeated with consent of advisor. Prereq: 5890, 5940, 6810, 6841. S/NC only.

Special Education and Rehabilitation

MAJORS DEGREES

Special Education M.S.

Vocational Rehabilitation Counseling M.S.


Lecturers: H. L. Byrd, J.D. Michigan; S. W. Mulkey, M.S. Tennessee; O. E. Reese, B.S. Memphis State.
An experience program for regular teachers, special teachers, and rehabilitation personnel may be planned to meet the needs of exceptional children and adults in relationship to the program of general and special education. Specialized courses may be distributed over the several areas of special needs with emphasis in an area of special interests or need. Facilities are available for continuous observation and participation in direct relationships with handicapped children and adults who are hospitalized, homebound, or in residential schools, special classes, or regular classes.

Course sequences may be planned in specialized areas to include: (1) acoustically handicapped; (2) gifted; (3) disability evaluation; (4) learning disabilities; (5) mentally retarded; (6) multiple disabilities; (7) speech correction; (8) socially or emotionally maladjusted; (9) rehabilitation counselor education.

Programs lead to the Master of Science degree in Special Education with emphasis in one of the specialized areas. Among the areas of specialization available is disability evaluation (non-thesis only).

Under the sponsorship of Social and Rehabilitation Services, a specialized institute for the preparation of professionals to adapt their skills toward services to 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 of the brain-injured child; skills for identifying educational, physical, and emotional characteristics; special educational techniques.

4150 Education of Hospitalized and Homebound Children (3) School and home responsibility 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 actions; the case evaluation process; 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 medical conditions, approximating the needs of exceptional children and adults in relationship to the program of general and special education. Emphasis on the study of written medical reports for the purpose of demonstrating evidence of medical conditions, approximating the course of the medical condition, and deriving loss of function. Prereq: Admission to program in Disability Evaluation 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 evaluations. 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 policies into disability insurance claims evaluation criteria; practical experience in designing, conducting, and reporting work evaluation procedures in a workshop setting. 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; evaluation structures; emphasis on problems of disability evaluation process or structures; emphasis on innovation, exploration of alternatives, and sharing experience within the group. 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).

5800 Disability Evaluation: Issues, Processes and Programs (4) Evolution of the philosophy and programs of disability insurance under Social Security; study of disability claims actions; the case evaluation process; principles of evidence. Prereq: Admission to program in Disability Evaluation or consent of instructor.

EDUCATION OF THE ACoustically Handicapped

4000 Rehabilitation Practicum (3) Evaluation of client data practicing rehabilitation procedures. 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 5040. (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: 4190 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. Prereq: 4210 or consent 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; speech and language development; auditory training; speech-reading; manual language and its relation to other forms of communication. Observations and practicum. (Student must acquire a degree of proficiency in the use of the language.)

4240 Nature of Hearing Impairments (3) Basic principles required by the hearing impaired person; speech and language development; hearing loss; methods and instrumentation for the assessment of hearing level; interpretation of audiograms; selection 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, developmental reading and specialized materials for curricula in teaching reading. Prereq: 4210 or consent of instructor.

4790 Student Teaching of Acoustically Handicapped Children (9) S/NC only.

4791 Practicum with Acoustically Handicapped Children (6) S/NC only.

4939 Laboratory in Aural Rehabilitation (1) (Same as Audiology and Speech Pathology 4939.)

5400 Advanced Clinical Practice in Audiology (1-6) (Same as Audiology 5400.)

5520 Linguistics in the Education of the Auditory Impaired (3) Research and developments in linguistics related to audiorially impaired.

5720 Seminar in Language Remediation for the Hearing Impaired (3) Projects and discussion will pertain to language developments in educational methodologies and to research pertaining to teaching language to the hearing impaired. Topics will include research and materials current in the use of various sign language systems and their adaptations, emphasis will be placed on approaches which accommodate and assist the integration of hearing impaired children in the regular classroom.

5726 Seminar in Educational Implications of Language Deficiency (3) Readings, discussion, and projects will concern 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 Manual Communication (2, 2, 2) Acquisition of basic and advanced skills in fingerspelled and signed forms of communication. Emphasis will be placed on approaches which accommodate and assist the integration of hearing impaired children in the regular classroom.

4510 Instructional Media for the Handicapped: Design, Production, and Evaluation of Prototypical Curriculum Materials (9) Perception, communication, and learning theories; media design and advanced production techniques; evaluation procedures. Emphasis on planning and producing prototypical media materials specifically designed to meet the needs of handicapped learners. Enrollment limited to persons holding major responsibilities for media in a program for the handicapped or similar setting. Prereq: 4410 or equivalent. (For Summer Media Institute only.)

5400 Educational and Vocational Guidance of the Deaf and the Hard of Hearing (3) (Same as Audiology and Speech Pathology 5400.)

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

5820 Curriculum Development Applied to Programs for the Hearing Impaired (3) Analysis of current curricula and methods to adapt them for hearing impaired individuals. Appli-
cation of new curriculum options in the education of these children. Implementation of current educational theories and practices for hearing impaired children. Prerequisite: 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 each other. Relationships with respect to personality characteristics and developmental factors interpreted through behavioral and psychological theories as well as practical situations in which learning and behavior disorders may occur.

4620 Education of the Emotionally Disturbed Child (3) Managing behaviors, models for instruction, teaching techniques and materials, and teacher-pupil family interpersonal relationships as basic to academic achievement for the pupil. Prerequisite: 4610.

4630 Practicum in Residential Settings Serving Children with Learning and Behavior Problems (3) Practicum in scientifically identifying, observing, and recording disturbing behaviors. Initiating behavioral management techniques for academic and social behaviors. Performance in a tutorial capacity within a residential classroom, and participation in discussion and evaluation of relevant academic curriculum and reinforcement schedules. Prerequisite: 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. Particular emphasis and practice in individualizing instruction for learning and behavior problem children within the regular classroom setting. Discussion and evaluation of relevant methods and materials unique to each teaching situation. Prerequisite: 4610 and 4620 or consent of instructor.

4924 Student Teaching of the Emotionally Disturbed (9) Individual tutoring and classroom observation and teaching. Prerequisite or Corequisite: 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. Prerequisite: Consent of instructor.

4120 Education of the Mentally Retarded Child (3) Philosophy and rationale underlying the teaching and guidance of the mentally retarded; methods and materials in special and regular classes. Prerequisite or Corequisite: 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) Prerequisite: Major in educable mentally retarded. S/NC only.

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

4922 Student Teaching of the Educable Mentally Retarded (9) Observation and supervised practicum. S/NC only.

5111 Psychology of Mental Retardation (3) Intellectual frameworks and theories of mental retardation and their theoretical and educational implications emphasized. Prerequisite.

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 educational models, methodologies and curriculum in the education of mentally retarded children and adults. Emphasis on the varied curriculum alternatives to the retarded child's education.

EDUCATION OF THE VISUALLY HANDICAPPED

4160 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 treatment; 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

4630 The Public School Speech and Hearing Program (3) Organization, administration, and procedures.

4940 Appraisal of Speech and Language Disorders (4) (Same as Audiology and Speech Pathology 4640).

4360 Stuttering (4) (Same as Audiology and Speech Pathology 4360).

4360-30-40 Clinical Practice in Speech Pathology (1-6) (Same as Audiology and Speech Pathology 4360-30-40).

4361 Clinical Practice in Speech Correction in the Public Schools (3) S/NC only.

4362 Seminar in Speech Correction in Public Schools (3) Prerequisite: Audiology and Speech Pathology 4360-30-40, Spec. Educ. 4360, and consent of instructor.

4400 Voice Disorders (4) Prerequisite: Speech Science II (Same as Audiology and Speech Pathology 4400).

4450-60-70 Clinical Practice in Audiology (1-6, 1-6, 1-6) (Same as Audiology and Speech Pathology 4450-60-70).

4720 Audiology II (3) (Same as Audiology and Speech Pathology 4720).

4930 Aural Rehabilitation: Speechreading and Auditory Training (4) (Same as Audiology and Speech Pathology 4930).

4939 Laboratory in Aural Rehabilitation (1) (Same as Audiology and Speech Pathology 4939).

4940 Advanced Aural Rehabilitation (4) (Same as Audiology and Speech Pathology 4940).

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

5380 Cerebral Palsy (3) (Same as Audiology and Speech Pathology 5380).

5390 Cerebral Palsy (3) (Same as Audiology and Speech Pathology 5380).

5640 Seminar in Language Pathology (3) (Same as Audiology and Speech Pathology 5640).

REHABILITATION COUNSELOR EDUCATION

5100 Orientation to Rehabilitation (3) History, philosophy, and legal bases for the rehabilitation movement; case finding, intake, diagnosis, physical restoration, counseling, training, placement, and follow-up; relation to programs of allied agencies, rehabilitation teams, facilities and programs in hospitals, institutions, community agencies, and service groups. Attention to rehabilitation and vocational counseling models such as the mental health, the mentally retarded, and the blind.

5110 Medical Aspects of Rehabilitation Counseling (3) Structure, function and pathologies of the body systems including disease processes and the residual function; other health problems in speech, vision, hearing, limbs and balance, as well as psychiatric areas; medical terminology and the physician-counselor relationship. Special attention to the rehabilitation implications of disabilities.

5120 Psychosocial Aspects of Disability (3) Medical aspects and psychological impact of major disabilities; rehabilitation processes including implications of family and community.

5136 Seminar in Rehabilitation (3, 3)

5156 Internship in Rehabilitation (9, 9)

5170 Systematic Human Relations Training I (3) Structured training group utilizing Carkhuff model for instruction and practice in basic helping skills necessary for a rehabilitation counselor.

5180 Systematic Human Relations Training II (3) Continued practice in Carkhuff model and preferred modes of treatment necessary for counseling rehabilitation clients. Prerequisite: 5170.

GENERAL COURSES

3353 Education of the Exceptional Child (3) Psychological characteristics and educational needs of children with learning disabilities; local and state programs for diagnosis and care; educational provisions in regular or special classes; special teaching; social and vocational guidance.

3520 Language-Speech Handicapped Child in the Classroom (3) Recognizing and understanding speech problems; observing normal and defective speech development in children; incorporating speech improvement activities into the curriculum. For students not majoring in speech and hearing.

3560-60-70 Problems in the Education of Exceptional Children (3, 3, 3) Prerequisite: Consent of instructor.

4740 Diagnostic and Remedial Approaches in Special Education and Rehabilitation (3) A critical examination of diagnostic tests and methods employed in measurement of educational needs of children and adults who are mentally retarded, learning disabled, multiply handicapped or physically handicapped.

5000 Thesis

5002 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.

5260 Education of Gifted Children (3) Curricular and social adjustments.

5400 Assessment and Remediation of Learning Disabilities (3) Theories and methods involved in identification and remediation of learning problems of children: neurological and medical aspects; task analysis of cognitive, affective, and psycho-motor skills and use of formal diagnostic testing material emphasizing cognitive development. Research dealing with optimizing teaching instruction combined with a prescriptive teaching approach to learning disabilities.

5401 Prescriptive Teaching for Children with Learning Disabilities (3) Diagnostic test materials to assess functional levels of ability followed by specific remedial recommendation consistent with functional ability level.
phasis on reading and mathematics skill development. Materials designed for ethnic populations, instruction in Bloom's taxonomy, assessment of sensory, linguistic, and motor development.

5403 Resource Teachers for the Handicapped (3) To help students acquire the skill to maintain mildly handicapped children in regular public education environments; includes job descriptions and expectations, interpersonal relations, assessments of abilities, modifications of curriculum content, and applied teaching methodologies.

5450-60-70 Experience in Teaching and Supervision of Exceptional Children (1-6, 1-6, 1-6)

5510-20-30 Administrative Practicum on Problems in Institutional Care of Children (3, 3, 3) Physical and social development; business and personnel management. Prereq: Training and experience in institutions for children, or consent of instructor.

5550-60-70 Problems in the Education of Exceptional Children (3, 3, 3)

5620 Counseling Parents of Exceptional Children (3) Interpreting exceptionalities (handicapped and gifted) to parents and helping in the understanding and acceptance of the child in the school/home.


5830 Seminar: Issues and Theories in the Education of the Exceptional Child (3) Current trends in the education of the exceptional child, application of philosophical approaches to their education, an analysis of current theories of integration as applied to the exceptional child. Review and discussion of current research concerning the education and/or rehabilitation of exceptional persons. Prereq: C & I 5800 or Ed. Psych. 5210 and consent of instructor.

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

5970 Juvenile Delinquency and the School (3) Responsibilities of the school in studying sources of maladjustment; the school function in community and in children's welfare; curricular adjustments; directed study of socially maladjusted children, their environment, and programs for meeting their needs.

Vocational-Technical Education

MAJORS

AGRICULTURAL EDUCATION

Agricultural Education

Business Education

Distributive Education

Home Economics Education

Industrial Education

Vocational-Technical Education

DEGREES

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College of Education

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

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

5320-30 Agricultural Education in Off-Farm Agricultural Occupations (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)

5490 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

5002 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.

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 VocationalTechnical Schools (3) (Same as Industrial Education 5140)

5410-20-30 Practicum in Business Education (3, 2, 3)

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: Clerical Practice (3)

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

5617 Problems in Business Education: Business Law (3)

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

5619 Problems in Business Education: Psychology and Skill Building (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.

4330 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, 4320.

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

5000 Thesis

5002 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.

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 appreciating the problems from the high school principal's and the department head's point of view. Trends in distributive education, including school supervisory, teacher-coordinator qualifications, the changing curriculum.

5120 Organizing and Teaching Adult Distributive Education (3) Planning, organizing, promoting, teaching, and evaluating continuing education programs in distributive education: utilization of trade 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.

5516-26-36 Problems in Distributive Education: Retailing (3, 3, 3)

Home Economics Education

5000 Thesis

5002 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.

5110 Advanced Methods of Teaching Home-Making 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 student emphasis on individual problems of evaluation.

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

5440 Curriculum Development and Implementation in Family Relationships Instruction (3) Review and organization of content for teaching family relationships. Analysis and evaluation of selected materials and methods in terms of their appropriateness for reaching curricular objectives in family relationships.

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

5530 Organization of the Home Economics 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.

5620 Wage Earning Programs in Home Economics (3) Planning, establishing and implementing wage earning programs in home economics.

5710-20-30 Special Problems for Non-Thesis Students (3, 3, 3)

5810-20-30 Problems in Home Economics Education (1-3, 1-3, 1-3) May be repeated. Maximum 3 hrs per course.

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)

3120-20-30 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)
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 specialist positions in various public, voluntary, private, and commercial agencies and institutions; 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. Forty-five quarter hours are required for the M.S. Approximately 23 quarter hours of work selected from courses numbered 5000 and above are included in the M.S. requirement. 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 all M.S. degree programs. A three-quarter hour course in research techniques and/or statistics and/or a seminar in research will be required. Each non-thesis degree candidate will take a final comprehensive examination.

Programs leading to the Master of Public Health are also available in community health education, occupational health, environmental health, industrial safety, and health planning. Fifty-four quarter hours are required for the M.P.H. degree. One full quarter of field practice is required. 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.

DOCTORAL PROGRAMS

The Doctor of Education and the Doctor of Philosophy degrees are offered in Health Education. See further description under Health 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.

c. A superior grade point average.

d. Submission of satisfactory references relating to training, employment, and character.

e. 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 made 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, supervising recreation field work students, 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 majoring in Community Health Education. 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

Health Education

Public Health Education

Safety Education and Service

School Health Education

DEGREES

Ed.D., Ph.D.

M.S., Ed.S.

R. H. Kirk (Chairman), H. S. D. Indiana; W. J. Huffman, Ed.D., Illinois; R. Kent, Ph.D., North Carolina; B. C. Wallace, Ed.D., Colorado State.

Associate Professors:

J. Gorski, Dr. P.H., U.C.L.A.; J. Huffman, Ed.D., Illinois; R. Kent, Ph.D.

Assistant Professors:


Lecturers:

M. Duffy, M.D., Pennsylvania; H. P. Hopkins, Ph.D., North Carolina; S. King, M.D., Emory; C. P. McCammon, M.D., Temple.

The Health and Safety Division offers the following degree programs:

Master of Public Health degree with a major in Public Health Education. (Option in Community 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 course work.

Educational Specialist degree in Safety Education and Service.

Doctor of Education degree in Health Education.

Doctor of Philosophy degree in Health Education.

Public Health

3000 Foundations of Health Science (3) In-depth study of the several content areas relating to present and contemporary health problems, i.e., mood modifying products, consumer health, international health, 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 18 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. Prerequisites: 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 public health 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 incidental to industry.

4220 Communications for Better Health (3) Selective study of communications in the health enterprise. Consideration in logical progression of the problems of transmitting current and pertinent 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 major consumer health and safety problems; selecting, purchasing, and financing of safety and medical services.

4421 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.) Prereq: 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, 2, 3) Field practice in public health under supervision of public health professional. S/NC only.

4730 Workshop in Public Health Education (3-6) For teachers, nurses, case workers, sanitarians, and other voluntary and public health agency personnel. Emphasizes the problem solving approach through small 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.

5002 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.

5010-20-30 Workshop in Public Health (3-4, 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, field practice. Prereq: Consent of instructor.


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 growing upon or intervening 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 with the emphasis upon types 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) Administrative 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.

5540 Factors in Problem Solving for Community Health (5) Test skills in communications and group process in 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 practical health communities. 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 organizations. 1 two-hour lecture-seminar session per week.

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

5705-65 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.)
6050-60 Seminar in Health Education (3, 3) (Same as School Health Ed. 6050-60.)
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 (3) Accident prevention and injury control in sports activities; philosophy of sports safety; human environmental factors and their interrelationship in sports injury 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
5002 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.
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 opportunity to engage 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.
3510 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, 3-6, 3-6) Deals with specific health problems. Designed especially to explore special health problems in a concentrated period of time.
5870-80-90 Current Issues in School Health Education (1, 1, 1)
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

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

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

3111 History of Dance and the Related Arts II (2) A survey of dance and the arts related to it during their development in the twentieth century.

3310 Tests and Measurements in Physical Education (3) Study of elementary statistics related 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, supervised by a departmental assistant.

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 (2) Theory and practice in leadership in organized group 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 3890).

4010 Advanced Dance Technique (2) Development, integration, and synthesis of previous dance vocabulary; emphasis on analysis and principles of dance techniques: solo and group work. Prereq: Intermediate Dance Technique.

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 and diagnosis of individuals 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 1-5. 3 hrs and 1 lab.

5000 Thesis

5002 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise registered during any quarter when such a student at a university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.

5110 Administrative Problems in Health and Physical Education (3)

5120 Problems of the Curriculum in Physical Education (3)

5130 Methods in Physical Education (3) Characteristics of different school age levels, and applications of learning procedures in physical activities at these 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 selected specialized area within the general fields of physical education. Prereq: Consent of instructor.

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: 4500. 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 (3) 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.)

5600 Applied Physiology (3) Principles of physiology with special emphasis on the application of physiological findings to practical problems related to human function. Prereq: one 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. Recommended: Recommended: Recommended: Recommended: Recommended: Recommended: Recommended: Physics, and mathematics 3 hrs and 1 lab.

5620 Experimental Techniques in Applied Physiology (3) Laboratory course in experimental methodology and instrumentation. Topics include respiratory and blood gas analysis, human calorimetry, blood chemistry, and pulmonary function tests. May be repeated with consent of instructor. S/NC only.

5650 Scientific Bases for Physical Education (3) Physiological, psychological, and sociological foundations.

5810-20-30 Seminar in Physical Education (1, 1, 1) Study of current issues and problems in physical education with emphasis on outstanding studies and research in the field.

5910-20-30 Problems and Projects in Physical Education (1-3, 1-3, 1-3) Problems of professional interest and value to the individual student, selected by the student and approved by the major professor. S/NC only.

6000 Doctoral Research and Dissertation

6010 Seminar in Physical Education (1) Research topics in the literature related to physical education. May be repeated with consent of the instructor. S/NC only.

6220 Independent Research (3) Selection of a topic and development of a project and conduct of a study including the final writing of a research paper. S/NC only.

6410 Practicum in Kinesiology (3) Electromyography laboratory and film analysis of sports skills. Prereq: First quarter Elements in Physics or equivalent. May be repeated with consent of instructor. S/NC only.

6510-20 Issues and Problems in Physical Education (3, 3) Critical examination and evaluation of current issues and problems in the area of physical education.

6610 Seminar in Exercise Physiology (2) Prereq: 5410. May be repeated with consent of the instructor. S/NC only.

6640 Research Participation in Applied Physiology (1-6) Advanced research techniques are studied under supervision of a faculty member whose research area coincides with interests of the student. Prereq: Consent of instructor. May be repeated with consent of instructor. S/NC only.

6810-20 Practicum (2, 2) Intern experience in areas of major interest. S/NC only.

Division of Recreation

MAJOR DEGREE

Recreation M.S.

Associate Professor: M. L. Peters (Chairman), Ph.D. Illinois.

Assistant Professors: P. A. Boroviak, M.S. Tennessee; C. J. Johnson, M.S. Illinois; P. A. Krick, Ph.D. Indiana.

The Recreation Division offers the following degree programs:

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

3100 Recreation Leadership Procedures (3) Principles and practice of recreation leadership; 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, 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 professionals to minority groups whose leisure opportunities and needs may require special services.

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

5002 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise registered during any quarter when such a student at a university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.
a student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated S/NC only.

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

5159 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.
Graduate degree programs of the College of Engineering provide opportunities for advanced study leading to the Master of Science degree, the Master of Engineering 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 a degree from UTK while carrying out 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 in any department of Industrial Engineering 4150, 5110, 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 5120 and 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. These electives shall include courses in business administration, other than economics, management science and statistics.

The program requirement totals 51 hours of graduate course credit. No thesis is required. A final oral and written examination must be passed on the work offered for the degree. Course prerequisites for the program are Accounting 5810, 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.

**Chemical and Metallurgical Engineering**

<table>
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<th>MAJORS</th>
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<td>Chemical Engineering</td>
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<td>Metallurgical Engineering</td>
<td>M.S., Ph.D.</td>
</tr>
<tr>
<td>Polymer Engineering</td>
<td>M.S., Ph.D.</td>
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**Procedures:**

- H. E. Johnson (Head), D. Eng. Yale;
- D. C. Bogae, Ph.D. Delawars;
- B. S. Buie, Ph.D. D. Massauchusites Institute of Technology;
- C. B. Brooks, Ph.D. Tennessee;
- E. S. Cline, Ph.D. California (Berkeley);
- L. W. Crawford, Ph.D. Cincinnati;
- D. L. Culberson, Ph.D. Texas;
- J. M. Holmes, Ph.D. Tennessee;
- H. W. Hsu, Ph.D. Wisconsin;
- S. H. Juy, Ph.D. Cincinnati;
- C. M. McHargue, Ph.D. Kentuck;
- F. Moore, Ph.D. Lou's ana State;
- B. F. Oliver, Ph.D. Pennsylvania State;
- J. J. Parona, Ph.D. Northwestern;
- J. W. Prados, Ph.D. Tennessee;
- J. E. Stumbrl, Ph.D. Tennessee;
- E. S. Stanbury, Ph.D. Cincinnati;
- C. O. Thomas, Ph.D. Tennessee;
- R. A. Vandermeer, Ph.D. Illinois Institute of Technology;
- J. S. Watson, Ph.D. Tennessee;
- J. L. White, Ph.D. Delaware;
- M. A. Wright, Ph.D. Wales,*

**Associate Professors:**

- W. T. Becker, Ph.D. Illinois;
- J. F. Fellers, Ph.D. Akron;
- G. C. Frazier, Ph.D. Johns Hopkins;

**Assistant Professors:**

- D. D. Bruus, Ph.D. Houston;
- P. J. Mescheter, Ph.D. Pennsylvania;

**Lecturers:**

- L. Dresner, Ph.D. Rensselaer;
- R. N. Lyon, Ph.D. Michigan;
- D. L. McEiroy, Ph.D. Tennessee;
- T. D. Parish, Ph.D. Rice;
- W. H. Seaton, Ph.D. Ohio State;
- E. von Helix, Ph.D. Tennessee;
- M. E. Whiteley, Ph.D. Iowa State.

**M.A. 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, or polymer engineering. The polymer engineering major must include Poly. Engr. 4920, 5110, 5230, 5310 and 5510.*

2. One or two minors or collateral work.

**DOCTORAL PROGRAM**

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

Department requirements consist essentially of the satisfactory completion of:

1. Graduate courses in chemical engineering, metallurgical engineering, or polymer engineering amounting to approximately 36 quarter hours, at least 12 of which must be in 6000 series courses.

2. Supervising 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, metallurgical, and polymer engineering operations and processes, thermodynamics, technology, mathematics, physics, chemistry, and other related fields.

4. Active participation in graduate seminar in 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. Appropriate languages are French, German, Italian, Japanese, Russian.

**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 (through chemical or metallurgical engineering) with polymer 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 Poly. Engr. 4910, 4920, 5110, 5230, and either 5310 or 5210 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 Poly. Engr. 4310 and 4920, Chemistry 5331 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.

Chemical Engineering

5010 Graduate Seminar (1-6) 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 pipes, tubing systems, and packed beds; metering devices, pumps. Prereq: Elementary Linear Algebra and Calculus of Several Variables, and Mass and Energy Relations 1st and 2nd yr. 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 packed beds and heat exchangers; condensation and boiling; radiation. Prereq: 3410, Thermodynamics of Phase Equilibrium. 3 hrs and 1 lab.

3440 Stagewise Operations (3) Analytical and graphical methods applied to stagewise separatory operations. Prereq: Thermodynamics of Phase Equilibrium.

3450 Diffusional Operations (3) Diffusion, simultaneous heat and mass transfer; applications including humidification, gas absorption, extraction. Prereq: 3420.

3610 Introduction to Process Dynamics and Control (3) Introduction to concepts of process dynamics and control. Steady state analysis of chemical process control systems. Unsteady state nature of chemical processes. Laplace transform techniques, block diagram algebra and transfer functions. Mathematical models for several processes are developed and analyzed in detail. Prereq: Introduction to Differential Equations.

3620 Chemical Process Control (3) Basic control theory applied to chemical processes; feedback and feedforward control, cascade control, stability analysis, frequency response, Survey of modern control of typical industrial unit operations. Prereq: 3610.

4110 Chemical Engineering Data Analysis (3) Analytical and experimental identification of system extremes; statistical properties of samples and source systems; empirical modeling of chemical process control. Prereq: 3420 and Math 3150.


4130 Introduction to Optimization (3) Principles and applications of various optimization techniques to statistical process design; unconstrained optimization, equality constrained optimization, inequality constrained optimization, sensitivity analysis and computer programming. Prereq: Differential Equations.

4160 Design of Separation Processes (3) Mass transfer theory applied to design of materials separation processes. Prereq: 3440.

4200 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) Special extension of 4420 for student participation in the A.I. Ch.E. annual contest problem; other advanced design projects. Prereq: 4410, 4530.

4450 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.

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

4540 Fluid-Solid Operations (3) Heat and mass transport in fixed and fluidized beds: applications include absorption, ion exchange, crystallization, and flotation. Prereq: 3420.

4620 Process Modeling, Stimulation, and Control of Chemical Processes (3) Development of process models, experimental process identification, plant models, computer simulation, conventional and non-conventional feedback control, advanced control concepts. Prereq: 3620 or equivalent background in basic control theory and differential equations.

4730 Mass and Energy Flow in Biological Systems (3) Basic physicochemical and organizational principles applicable to biological systems. Derivations of general equations of bio-mass and energy transfer. Thermodynamics of transport and equilibrium in biological systems. Discussion of Volterra's equation and biological clocks, etc. 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; food processing and pharmaceutical processes. Prereq: 3440, 3450 or consent of instructor.

4760 Principles of Biochemical Separation (3) Fundamental aspects and similarities of modern biochemical separation methods; classroom demonstrations, design of production and analytical systems. Prereq: 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.

5000 Thesis

5111 Chemical Engineering Analysis (3) Mathematical formulation and solution of differential equations arising in chemical engineering, especially those of heat and mass transfer, chemical reaction, biological system models, conformal mapping. Prereq: Differential Equations.

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

5130 Methods of Optimization (3) Principles and applications of various mathematical programs in chemical technology. 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: Thermodynamics.

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

5410-20-30 Research and Design in Chemical Engineering (3, 3, 3) Selected differential operating processes, interpretation of laboratory and design of experiments in chemical engineer-

5450 Chemical Reactor Design (3) Non-ideal flow patterns in chemical reactions; design and reaction in two phase systems; introduction to heterogeneous catalysts and reactor stability. Prereq: 4530.

5610 Stagewise Mass Transfer Operations (3) Chemical engineering of stagewise transfer operations, emphasizing non-isothermal and multicomponent systems.

5620 Differential Mass Transfer Operations (3) Differential mass transfer operations; falling film, packed tower and bubble contacting devices; non-isothermal and multicomponent systems; current theories of mass transfer; mass heat and momentum transfer analogies. Prereq: Differential Equations.

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

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 engineering and biochemical students. Prereq: 5310.

6320 Statistical Thermodynamics of Non-Equilibrium System (3) A review of elementary kinetic theory, introduction to modern kinetic theory, development of theories of thermal conductivity, viscosity, and diffusion...

6420 Stability Phenomena in Chemical Engineering: Continuous Systems (3) Hysteresis from instabilities and instabilities in fluids based upon interaction of fluid dynamic phenomena with thermal processes and chemical reactions. Emphasis on formulation of problems and methods of solution. Typical applications include stability of jets and formation of emulsions, Benard instability, Maragoni 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, catalyst effectiveness and the role of transport in kinetics. Emphasis is on development of a phenomenological description although mechanistic models are discussed. Prereq: 5510.

6520 Catalytic Reactor Design (3) Principles of kinetics, heat and mass transfer applied to the design and analysis of heterogeneous catalytic reactors. Prereq: 5610.

6510 Special Topics in Chemical Engineering (3) Advanced problems of current interest to chemical engineers. Prereq: Consent of instructor.

6710 Process Dynamics (3) Development of frequency, step, and pulse response methods. Prereq: Consent of instructor.

6520 Applied Chemical Reaction Kinetics (3) Principles of kinetics, heat and mass transfer applied to the design and analysis of heterogeneous catalytic reactors. Prereq: 5610.

3110 Engineering Materials I (4) Introductory course correlating the atomic, crystal, and microstructure of solids with mechanical, physical, and chemical properties 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 or Engineering Materials I or Process Principles and Materials III.


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

3320 Phase Transformations (4) Thermodynamic and structural factors governing bulk equilibrium. Ternary 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 (4) Principles of the mechanics of processing, chemical considerations in design of chemical process equipment. Prereq: 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 performance in engineering structures and components. Coreq: 4740. 3 labs.

4510-20 X-Ray Diffraction and Crystallography (3, 3) Lecture and laboratory work in crystallography; diffractions, 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 mechanical properties. 3 hrs or 2 hrs and 1 lab.

4710 Production Metallurgy (3) Thermodynamic and kinetic principles of plastic deformation, smelting and refining. Prereq: Thermodynamics.

4720 Mechanical Metallurgy I (3) Elastic behavior. Description of stress, strain, and elastic constants of materials; relationship between metallurgical structure and properties. Prereq: Physical Metallurgy II. 3 hrs or 2 hrs and 1 lab.

4730 Production Metallurgy II (3) Ductile and brittle fracture, creep and stress rupture, fatigue, and residual stresses. Effects of stress, loading rate, temperature and metallurgical structure. Prereq: 3120 or 3320, and 4730 or M.E. 3660 or consent of instructor. Also suggested for mechanical engineering, engineering mechanics, or engineering science students. 3 hrs or 2 hrs and 1 lab.

4750 Casting and Welding (3) Principles and processes of casting and welding; heat transfer, solidification, segregation, gas-metal slags, and internal stresses; thermal treatment, associated stresses. Prereq: 3230, 3 hrs or 2 hrs and 1 lab.

4770 Mechanical Metallurgy III (3) Finite plastic strain. Stress-strain relations. Principles of fabrication: forging, swaging, extrusion, rolling, deep drawing. Prereq: 4730 or consent of instructor. Also suggested for mechanical engineering, engineering mechanics, and engineering science majors. 3 hrs or 2 hrs and 1 lab.

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5110 Point Defects and Dislocations (3) Theoretical and experimental analysis of point line, and planar imperfections in solids. Prereq: 4730 or consent of instructor.

5120 Plastic Deformation I (3) Geometry and mechanisms of plastic deformation of single crystals, slip and twinning; work hardening; effects of cold and hot working. Prereq: 4730.

5130 Plastic Deformation II (3) Plastic deformation of polycrystalline materials; theoretical and experimental analysis of texture formation resulting from deformation and annealing. Prereq: 5120.

5140 Diffusion and Annealing in Solids (3) Analysis of models and experimental observations relating to diffusion processes and the theoretical and mechanical description of diffusion and annealing of point defects and cold work.

5150 Phase Transformations I (3) Analysis of models and experimental observations relating to phase transformations by nucleation and growth; solidification, precipitation, spinodal decomposition. Prereq: 5140.


5210-30 Welding Metallurgy (3, 3, 3) Welding processes and the physical metallurgy of welding, including power supplies, heat flow, residual stresses, solidification, and solid state reactions; for both simple and complex alloys. Current theories of cold cracking, hot cracking and porosity formation are developed. Prereq: Physical Metallurgy.

5310 Solidification and Crystal Growth I (3) Solute redistribution, thermodynamic considerations, kinetic, convection and fluid flow effects on the solid to liquid transition. Prereq: Math 4500.

5410-30 Advanced X-Ray Diffraction (3, 3, 3) Review of the statistical aspects of the crystal structure. Modern electronic diffraction theory, analysis of scattered intensity in reciprocal space; relationship of scattered intensity to thermal motion, order-disorder, particle size and lattice faults. Introduction to crystal symmetry, space group theory, and crystal structure problems; some laboratory work. Prereq: Math 4610.

5590-20 Applied Properties of Solids (3, 3) Survey course in the properties of solids; crystallography, x-rays, properties of single and polycrystalline; kinetics and thermodynamics of solid reactions, diffusion.

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: 4610-20.

5610-20 Radiation Effects on Materials (3, 3) The interaction of radiation with solid matter, radiation-induced changes in physical and mechanical properties, theory and experiment.
The effect of radiation on solid state reactions. Phenomena associated with the use of engineering materials in radiation environments. Prereq: Math 4840, Physics 3730 or consent of instructor.

5750 Corrosion (3) Analysis of corrosion processes in terms of polarization measurements and the Pourbaix diagram. Influence of structural variations in parent metal and localized corrosion contributing to pitting, crevice, and stress corrosion.

5810-20-30 Special Topics in Metallurgy (3, 3, 3) Lectures and recitation on more recent advances in the field, with special emphasis on mechanical behavior in service, testing, and fabrication.

5910-20-30 Metallurgical Thermodynamics (3, 3, 3) Application of thermodynamic and physicochemical methods to metals and metalurgical reactions. Relation of theory and experiment to the structure of liquid and solid solutions, and to alloy systems.

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6110-20-30 Theoretical Metallurgy (3, 3, 3) Study of those phases of solid state physics applicable to metals and metalurgical systems. Emphasis on quantum theory, specific heats, electron theory, electrical and thermal conductivity, magnetic properties. Prereq: alloy formation. Prereq: 4610 or Physics 3720; Math 4550 and consent of instructor.

6210-20-30 Rate Process in Metallurgy (3, 3, 3) Theoretical and practical considerations of rate processes in solids such as diffusion, recrystallization and grain growth, and phase transformations.

6320 Solidification and Crystal Growth II and III (3, 3) Fluid flow, magnetohydrodynamic effects in incompressible liquid conductors, morphology, stability of steady state coupled heat and mass transfer processes in liquid to solid transition, multi-phase solidification, compositional, non-steady state dendritic phenomena, some nucleation phenomena. Prereq: 5310.

6410-20 Thermodynamics of Solids (3, 3) Classical and statistical thermodynamic analysis of the stability of solid solutions, components and ordered structures. 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 Mat. Eng. and Math 4050 or 4710 or consent of instructor.

6820 Mechanical and Physical Properties of Crystals II (3) Continuation of Metallurgical Engineering 6610 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.

Polymer Engineering

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: Senior standing in engineering or science.

4920 Polymer Processing (3) Rheological properties of polymer melts and solutions, viscometry, unit operations of fiber, plastics and rubber industry: dimensional analysis and scale-up, flow through dies and pipelines, screw extruders and localized control, contributing to pitting, crevice, and stress corrosion.

4930 Principles of Fiber and Textile Engineering (3) Chemical and structural characteristics of important fibers; melt and wet spinning of man-made fibers; drawing and texturizing; preparation of yarn; dying, weaving and knitting; Emphasis on quantitative aspects. Prereq: Senior standing in engineering or science.

4940 Plastics Fabrication Operations (3) Lecture and laboratory course treating unit operations of the plastics industry. Types and mechanisms of operation of machinery used and the structure and properties of fabricated parts. Operations to include: extrusion; co-extrusion, injection molding including structural foam, thermoforming, blow molding, rotational molding, etc. Prereq: Senior standing in engineering or science.

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5110 Structural Characterization of Polymers (3) Experimental methods of determining the nature of transition and structural characteristics of polymers most pertinent to plastics, fibers, and rubber applications. Methods of determination of tacticity, crystalline structure, orientations, morphology, etc., including X-ray diffraction, nuclear magnetic resonance, and electron microscopy.


5230 Mechanical Behavior of Solid Polymers (3) Application of linear viscoelasticity and large deformation elasticity to solid polymer (especially vulcanized rubber and crystalline polymer) properties. Topics include dynamic modulus and loss tangent, wave propagation, friction, tensile failure, abrasion. Experimental methods of determining properties. Prereq: Mechanics of Materials.

5240 Yarn and Fabric Mechanics (3) Mechanical behavior of single fibers, deformation mechanics of continuous filaments, roving, yarns, researches of Hare, deformation mechanics of woven and knit fabrics.

5510 Polymer Solution Properties and Characterization (3) Molecular weight determination, chromatography, solution thermodynamics, phase separation; application to synthetic and naturally occurring macromolecules. Prereq: Undergraduate physical chemistry.

5510 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 melt flow properties, calorimetry, and dynamic mechanical measurements. Coreq: 5310.

5710 Phase Transformations in Polymer Systems (3) Analysis of nucleation and growth of phases in polymer systems, analysis of compatibilization; application to crystallization from the melt, precipitation from solution.

5910-20-30 Selected Topics in Polymer Science (3, 3, 3) Advanced problems in modern polymer research of current interest to engineers. Prereq: 4910, 4920 or equivalent. (Same as Chem. 5150-60-70.)

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6110 Optical Properties of Polymers (3) Maxwell's equations and the electromagnetic theory of light, optical properties of isotropic and anisotropic dielectrics including theory of birefringence, applications to spherulitic structures and fibers studies of Stein, light scattering from polymer films.

6150 Advanced X-Ray Diffraction Methods for Characterization of Macromolecules (3) Classical methods of crystal structure determination; Patterson and Fourier functions; helical nets and Bessel function techniques; levels of order, thermal motions, defects, disorder-transitions and paracrystalinity. Experimental methods including precision and Weissenberg photomontage of single crystal x-ray crystallography with applications to synthetic and biological macromolecules.

6210 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 polymer constitutive equations, selected applications, especially in fluid viscoelasticity. Prereq: 5210 or Engr. Sci. & Mech. 5410 or Met. Engr. 5640 or consent of instructor. (Same as Engr. Sci. & Mech. 6600.)

6220 Advanced Methods in Polymer Processing (3) Application of theories of rheological properties and structures formation to analysis of polymer process operations. Prereq: 5210.

6230 Advanced Mechanical Behavior of Polymers (3) Stress-strain responses with an emphasis on developing constitutive equations for the yielding behavior of solid polymers, failure analysis and design generation through molecular and solid polymers. Relation of microscopic properties to molecular structure.

6610 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: Consent of instructor.

6910-20-30 Recent Advances in Polymer Science and Engineering (3, 3, 3) Treatment of latest developments in science and technology of modern polymers. Include topics of morphology, structure, characterization, etc. Prereq: Consent of instructor.
Option I or II must be approved by the department.

Normally, the graduate program of study will be adjusted by the head of the department and the student's committee to suit the individual academic requirements.

MASTER OF ENGINEERING PROGRAM

Graduate programs in civil engineering and in environmental engineering leading to the degree of Master of Engineering are available to qualified graduates of ECPD accredited undergraduate curricula in civil engineering or environmental engineering. At least one-third of the program of study must be classified as engineering design. The student's advisor will assist in planning the program of study to ensure that it includes the necessary design content. The thesis and non-thesis options noted under the Master of Science Programs are also available under these programs.

DOCTORAL PROGRAM

A graduate program leading to the degree of Doctor of Philosophy is offered in Civil Engineering. Major fields of study include environmental engineering, structural engineering, and transportation planning.

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

1. A minimum of 108 quarter hours credit beyond the Bachelor's degree, exclusive of credit for the M.S. thesis. Of this number, a minimum of 36 quarter hours credit in Doctoral Research and Dissertation will be required.

2. A minimum of 36 quarter hours of graduate courses in the Civil Engineering department, exclusive of thesis or dissertation credit, at least nine hours of which must be 6000-level courses.

3. 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 courses as mechanics, chemistry, mathematics, microbiology, physics, and other engineering fields. A minimum of 12 quarter hours of mathematics will be required beyond the civil engineering undergraduate requirements.

4. One foreign language if the student's faculty committee feels that a reading knowledge of a foreign language is crucial to the student's research efforts.

5. Upon completion of at least one-half of all course work, each student must pass a preliminary examination.

6. After completion of the dissertation, prior to graduation, each student must pass a final examination administered by a faculty committee.

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.


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

4420 Analysis of Framed Structures (3) Maximum stresses due to 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) Equipment associated with concrete 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 typical short span highway bridges in 4520. Prereq: Design of Framed Structures for 4510; and Concrete Design for 4520.


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 engineering properties of in-situ soils. Prereq: 5520 or consent of instructor. 2 hrs and 1 lab.

4560 Stabilization of Soils (3) Mechanical stabilization 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, geometries and lighting; on the land side are included terminal layout and design, and ground access systems and parking. Prereqs: Transportation 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.

4660 Airport Planning and Design II (3) Integration 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

5270 Planning and Transportation (3) Methods and techniques; other uses of asphalt products. Prereq: Materials of Construction. 2 hrs and 1 lab.

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

5000 Thesis

5002 Non-Thesis Graduation Completion (2) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.

5110-50 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 combination linear and space frames. Prereq: 5110 and 5120.

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

5160 Analysis and Design of Plate Structures (3) Theoretical principles of bending and buckling of plates; practical application of 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; plain stress, plain strain, axisymmetric, and three-dimensional elements; use of computers. Prereq: 5150, and Engr. Mech. 5820 or 5860. (Same as Engr. Mech. 5810.)

5220 Pavement Design (3) Characteristics of pavement loads; theory of pavement design; design of asphaltic and concrete pavements. Prereq: 5180.

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


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 Ad-

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

5550 Soil Mechanics—Plastic Equilibrium (3) Review of failure theories; earth pressure analysis, bearing capacity analysis, and slope stability analysis. Prereq: Physical Properties of Soils or consent of instructor.

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 embankment failures. Prereq: Physical Properties of Soils or consent of instructor.

5610 Behavior of Steel Structures (3) Behavior of structural steel members due to static and transient loads; relationship between research results and current specifications for design. Prereq: Design of Framed Structures.

5730 Prestressed Concrete (3) Properties of prestressing materials and anchorage systems; methods of analysis and design of prestressed concrete; analysis and design of members and continuous structures.

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

5800 Urban Systems: Engineering and Management (3) The planning and engineering of the various urban systems usually under the responsibility of a city manager and/or city engineer such as streets, lighting, water, sewerage, refuse collection, etc. Prereq: Graduating 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: Sociology 3450 or 5511. 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 design; computer-operated, computerized networks; legal aspects of operational controls. Prereq: 5810. 2 hrs and one 2-hr lab.

5840 Geometric Design (3) Advanced theory and procedures for the design of highways. Prereq: 5890. 2 hrs and one 2-hr lab.

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 cross-section, intersections, utility considerations, parking, effect of mass transportation, channelization, marketing, lighting; the freeway, frontage road, surface street system. Prereq: Consent of instructor.

5860 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 process as required for the study of person movement by public transportation. Also includes the nature of public transit: its various modes, their impact on the community's need; user preferences; modal split models; and the total social, political, economic and fiscal impacts of public transit. Prereq: Highway Engineering I or graduate standing.

5890 Traffic Accident Reconstruction (3) The interaction of traffic control data collection and analysis is discussed as a basis of designing accident prevention or control programs. Emphasis is on examining the many contributing factors to an accident. Proximate and secondary accident causes will be discussed and may they may be falls, roadways, improvements. Prereq: 4640 or 5810 or consent of instructor.

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

5910-20-30 Special Topics (3, 3, 3) Analysis and design of certain civil engineering structures not included in other courses such as arches, long span and movable bridges, complicated trusses, etc.

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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: 5170 and 5610.

6740 Behavior of Reinforced Concrete Beams and Frames (3) Ultimate strength and behavior of statically determinate and statically indeterminate reinforced concrete structures; applicability of elastic analysis to framed structures, limit analysis. Prereq: 5120 and 5170.

6750 Behavior of Reinforced Concrete Slabs (3) Behavior, analysis and design of reinforced concrete slabs; finite element solutions; ACI Code methods; yield-line theory. Prereq: 5740, 5160 or EN 6310.

6830 Traffic Flow Theory (3) Special problems in traffic engineering, using queuing theory, Markov processes, Monte Carlo methods, and simulations of various conditions and/or designs. Prereq: 4540 or Math 5150; 5820.

6850 Statewide Passenger Transportation Planning (3) Preparation of comprehensive multi-modal transportation plan, intercity traffic models, functional classification, programming and scheduling. Emphasis on government policy decisions, especially as they affect air and highway investments. Prereq: 5560.

6870 Future Transit Technology and Research (3) New transit systems and new technology are identified and evaluated. Also considered are the effects of new technologies on existing urban modes and areas in both technology and the planning process and possible research designs. Prereq: 5560.

6880 Planning Models for Transportation Systems I (3) An analytical analysis of trip generation employing mathematical, statistical, and computer science techniques. Also an introduction to modal split, trip distribution, and trip assignment will be made. These statistical procedures are integrated into the urban transportation planning process. State-of-the-art and new modeling techniques are investigated. Prereq: 5560 or 5270, Math 3150 and Stat. 3450.

6890 Planning Models for Transportation Systems II (3) An analytical analysis of modal split, trip distribution, and trip assignment. Methodological, statistical, and computer science techniques are used in the modelling process. These models are integrated for use in the urban transportation planning process. Prereq: 5560.

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.


4510 Urban Water Management (3) Introduction to urban water modelling; evaluation of optimum urban water policies; formulation of system constraints and analysis of decision-making process; management of storm water for beneficial use. Prereq: 3000 and Elementary Hydrology.

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

4220 Water Resources Engineering Development (3) Prereq: 3000. Resource development, development and single or multipurpose planning; economics in alternative decisions; principal watershed; multiplicative evaluation procedures for water and resource projects; Tennessee water law principles; special topics of current interest. Prereq: Consent of Instructor.

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


4520 Elements of Water and Wastewater Treatment Systems Design (3) An introduction to the unit operations and processes employed in the physical, chemical, and biological treatment of water. Application to unit operations and processes in design of water and wastewater treatment plants. Prereq: Elementary Hydrology.

4530 Sanitary Engineering Laboratory (3) Physical, chemical, and bacteriological analysis of water and wastewater. Prereq: 4030. 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 sources; meteorology 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 in water law doctrines. (Same as Water Res. Development 4810.)

5000 Thesis

5002 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise completing the specified requirements. Must be pursued during the student's junior and senior years. A student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated for credit.

5150 Water and Urban Wastefare (3) Evaluation of social, environmental and economic impact on planning and management of urban water systems. Emphasis upon conflict and choice, reconciliation of objectives, analysis of system and develop values, measurement of social well-being and quality of life parameters. Procedures for analyzing multi-objective policy alternatives with selected case studies. Prereq: Consent of instructor.

5160 Planning and Utilities (3) Planning for adequate water and sewage disposal waste disposal in the urban environment. The impact of utility patterns on area development, and the plowing water, utility, service policies. Not for civil engineering majors. (Same as Planning 5160 and Water Res. Development 5160.)

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

5210 Advanced Water Resources Engineering (3) Complex problems encountered in water resources engineering such as water hammer, surge calculation, water line design, etc. Analysis of such problems preliminary to design of complex water resources structures.

5230 Surface Water Transport Processes (3) Dynamics of flow in porous media with emphasis on streamflow quantity and quality; numerical methods, Hele-Shaw, and graphical solutions of flow equations; Dupuit approximation, analog and numerical methods. Prereq: Consent of instructor.

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

5241 Flood Damage Reduction (3) Survey of national, regional, local flood problems; hydrologic design criteria; traditional flood control measures; land-use controls and adjustments; floodproofing, flood insurance, and other flood damage reduction elements; interdisciplinary approaches. Prereq: Consent of instructor.

5261 Basic Principles of Remote Sensing (3) Introduction to the applications of remote sensing in agriculture, engineering, forestry, meteorology, and resource management; properties of electromagnetic radiation including wave theory, physical and geometrical aspects of EM 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 special application and limitation; use of remote sensing platforms, including the Earth Resources Satellite Communications and Tracking Planning, Prereq: 5261 or consent of instructor.


5301 Stormwater Modeling (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 the simplified response. Methods are presented for optimizing model parameters with illustrative examples. Prereq: Consent of instructor.

5302 Stormwater Modeling II (3) Continuous streamflow records are interpreted using methods of systems analysis, including flow frequency and time series analysis. Hydrologic design of water resources systems using streamflow data. Analytical techniques including autoregressive and fractional gaussian noise models. Prereq: Consent of instructor.

5310 Groundwater Transport Processes (3) Dynamics of flow in porous media with emphasis on streamflow quantity and quality; numerical methods, Hele-Shaw, and graphical solutions of flow equations; Dupuit approximation, analog and numerical methods. Prereq: Consent of instructor.

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: 4220.

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

5513 Advanced Water and Waste Treatment Systems Development (3) Course centers about the relationship between environmental engineering and natural system behavior by focusing on eutrophication and the limiting nutrient concept in relation to research on the subject and its translation into law and wastewater engineering practice. Course conduct is in the seminar—open discussion format which actively involves all student participants. Prereq: Graduates standing or consent of instructor.

5551 Water Quality Management (3) Water quality control objectives, methods, and philosophies; water quality criteria; effect of various uses on water quality; receiving water characteristics and impact; regulatory standards; economic considerations. Prereq: 3000 or consent of instructor.

5551 Aquatic Environment Pollution (3) A study of the effects resulting from agricultural, municipal, and industrial pollution upon the aquatic environment, its effects on earth and its relation to man. Not for civil engineering majors. (Same as Water Res. Development 5530.)

5552 Microbiology for Sanitary Engineers (3) A study of microorganisms and microbiological processes which are significant in sanitary engineering, including basic microbiology, detection and identification, enzymes, metabolic reactions, oxygen and carbon growth; aerobic and anaerobic biological treatment processes. Prereq: Graduate standing.

5593 Advanced Sanitary Engineering Laboratory (3) Advanced laboratory techniques used in the analysis of water and wastewater. Application of modern instrumental procedures for physical, chemical, and biological analysis. Prereq: 5530, 3 labs.

5700 Planning and Air Pollution Control (3) The relationship between air pollution, population growth, development, and urban growth. Social, economic, and political processes involved in air pollution control. Prereq: 4700 and Fluid Mechanics.

5710 Air Pollution Control Engineering (3) Emission control systems for industrial and power generating processes, stack sampling methods, air monitoring, design of specific devices and systems. Prereq: 5720.

5720 Air Pollution Particle Collection Theory (3) The mechanics of particles suspended in a gaseous medium including particle motion, 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 pollutants. Computation and design 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, thermodynamics of moist air, and the thermodynamics of dry and moist air. Prereq: Math 4550 and Fluid Mechanics or equivalent.

5750 Turbulence in the Atmosphere (3) Presence and magnitude of turbulence in the atmosphere. Theoretical boundary layer mean wind and temperature profiles are derived and related to observations of pollutants. 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 classical derivations reviewed. Specific topics include the rise of buoyant plumes, the relation between Eulerian and Lagrangian means, and the differences between instantaneous and continuous sources, diffusion in a zone of wind shear and diffusion from urban source. Prereq: 5740.

5900 Special Problems in Environmental Engineering (1-6) Study of environmental engineering problems to fulfill the special problem requirement in the non-thesis program. Enrollment limited to environmental engineering students in the non-thesis program. Prereq: Consent of instructor. May be repeated. Maximum 9 hrs. S/N/C 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. S/N/C only.

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


6500 Industrial Waste Treatability and Process Control (6) Sources and characteristics of industrial wastes; treatment alternatives related to ultimate disposal; treatment processes and plant design and control. Prereq: chemical, physical, and biological processes using laboratory bench-scale treatment units, or field trips, 2 hrs and 4 labs. Prereq: 5513 and 5593.

6820 Advanced Theory and Applications in Water Resources Energy Systems I (3) Advanced theory on convection and conductive heat transfer, turbulent heat diffusion and mass-transport mechanisms in open channels, applications of energy balance to the plant discharge heat, and stratified flow phenomena. Prereq: 6110 or equivalent.

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 given in any one year. Prerequisite to all graduate courses: Consent of instructor.

Electrical Engineering

MAJOR DEGREES

Electrical Engineering

M.E., M.S., Ph.D.

Professors:


Associate Professors:

A. O. Bishop, Ph.D. Clemson; R. C. Gonzalez, Ph.D. Florida; E. L. Hell, Ph.D. Missouri; H. M. Lofthus, Ph.D. Louisiana; H. P. Metz, Ph.D. Auburn, P.E.; M. O. Pace, Ph.D. Georgia Institute of Technology; D. Rosenberg, Ph.D. New York; H. M. Sagi (Emeritus), M.S. Columbia, P.E.; F. M. Sholiner, Ph.D. Tennessee, P.E.; F. W. Symonds, Ph.D. Nottingham (UK).

Assistant Professors:

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

M A S T E R O F S C I E N C E 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 evenings. Graduate assistantships 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 5710. Elect. Engr. 5710 is normally available in both fall and spring quarters. Students electing courses such as 5650-60, 5720-30, or 5750-60 which require 5710 as a prerequisite should register for 5710 in the fall quarter.

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 electrical engineering and nine quarter hours in 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.

M A S T E R O F E N G I N E E R I N G PROGRAM

A graduate program leading to the Master of Engineering degree is available to qualified graduates of ECPD accredited undergraduate curricula in electrical engineering or its equivalent.

Specific degree requirements which must be met include:

1. Electrical Engineering 5070-80 and 5710.

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 submitted 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 9 quarter hours of 6000-level work in electrical engineering and 9 quarter hours in another approved area.

4. Master's thesis, totaling 9 quarter hours or more.

5. A final oral examination covering the thesis and related course work.

A minimum of one-third of the program must be in engineering design, and one-third in one of, or a combination of, advanced math, computer sciences, basic sciences, or engineering sciences.

D O C T O R A L PROGRAM

The Ph.D. degree with a major in Electrical Engineering may be pursued in the areas of circuit theory, computers, electro-optics, communication theory, electromagnetism, 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. A minimum of 36 quarter hours of work in electrical engineering at the 5000- and 6000-levels.

b. A minimum of 12 quarter hours of 6000-level course work. At least three quarter hours of this work must be in an area other than the student's major area.

c. 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.

3010 Transient Analysis (3) Analysis of transient response of networks and systems; Laplace transform method and classical differential equation methods for system analysis; complex frequency concept and pole-zero concepts; applications to engineering problems. Prereq: Circuits III.


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

3060 Propagation I (3) Plane waves, reflection, guided waves, transmission lines, standing waves, impedance, impedance matching, graphical methods, rectangular wave guides. Prereq: 3050. 4 labs.

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. machinery. Prereq: 3040. 4 labs.

3090 Energy System Operation (3) Synchronous machines, transformers, 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. 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.

3180 Logic Design of Digital Systems (3) Introduction to boolean algebra and design of combinational circuits. Presents gate and flipflop characteristics. Design of clocked sequential circuits and other systems containing memory. Introduction to minicomputer architectures and system components to include basic structure and function of Arithmetic, Storage, Input/Output, and Control Systems. Instruction set capabilities and machine language, programming. Prereq: 3010, Computer Science 3160. 4 labs.

3190 Plasma I (3) Engineering applications of physical electronics, plasma effects and devices. Topics include plasma principles and plasma light sources, laser 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 analysis of linear systems; load steady-state response; load-functions, frequency, gain-phase, and polar plots; block diagram transformation; signal flow graphs; analog computer systems; properties of second order systems; introduction to feedback theory; stability criteria. Prereq: 3010 and Math 3150. Occasional labs. Coreq: 3190.

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.

3830 Electronics III—Basic Electronic Amplifiers (3) Vacuum tube and transistor R-C coupled amplifiers; feedback; bias stability, feedback. Prereq: 3010 and 3820. Coreq: 3720. 4 labs.

4020 Direct Electrical Energy Conversion (3) Basic principles, typical devices and applications for the production of electrical energy by thermoelectric effects, thermionic conversion, magnetohydrodynamics, solar cells, and fuel cells. Laboratory demonstrations. Prereq: 3050, 3190, 3810, and ME 3530.

4080 Microwave Circuits and Electronics (3) Circuits represented by wave shattering, isolators, gyrators, couplers, microwave vacuum diodes and klystrons, microwave diodes and klystrons, and parametric amplifiers, power generator semiconductor, varactor semiconductors. Prereq: 3080. 4 labs.

4090 Propagation (3) Metal tube, dielectric rod, and stripline waveguides. Waveguide resonators and other loading components. Design of structures utilized for microwave power transmission and for microwave integrated circuits. Prereq: 3080. 4 labs.

4100 Digital Communication Systems (3) Principles of pulse and digital communication systems, pulse and digital modulation, discrete and continuous time operations (e.g. photographic emulsions) and temporal detectors (e.g. photodiodes) will be given. The last third of the course will be devoted to selected electro-optic instrumentation systems (e.g. laser light scatterers, optical data processing, holographic interferometry).

4110 Electromagnetic Field Transients (3) Pulse propagation on lines, reflection of pulses, time domain reflectometry, radiation of pulses from antennas. Prereq: 3060. 4 labs.

4200 Electromagnetic Field Transients (3) Pulse propagation on lines, reflection of pulses, time domain reflectometry, radiation of pulses from antennas. Prereq: 3060. 4 labs.


4370 Introduction to Feedback System Design (3) Mathematical formulation of control systems; steady-state error and error constants; root-locus method; optimum gain adjustments; compensation networks; introduction to compensation. Prereq: 3720. Lab optional.

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: 3090.

4420 Power Systems Analysis (3) System studies including load flow, faults, and stability. Prereq: 3090.

4430 Transmission, Distribution, and Protection (3) Study of underground and d.c. transmission; considerations of power transmission and insulation requirements; system protection against faults. Prereq: 3090.

4450 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.

4470 Plasma II (3) Magnetohydrodynamics. Prereq: 3190.

4480 Plasma III (3) Introduction to macroscopic plasma equations, particle orbits, interactions, oscillations, and waves. Prereq: 3190.


4500 Electro-Optical Detection and Instrumentation (3) Sensitivity, resolution (frequency response) and noise concepts of and practical engineering devices used in both optical and electrical systems. Prereq: Physics 2050 or equivalent. 4 labs.


4570 Electro-Acoustics (3) Reproduction of monophonic and stereophonic sound, microphone design, loud speakers, disc recording, magnetic recording, film recording; acoustics of studies, auditoriums.

4590 Instrumentation Transducers and Signal Conditioning Electronics (3) Various sensors and transducers utilized for parameter measurement. Use of the operational amplifier in signal-conditioning; design examples such as active filters, amplifiers, attenuators, and function generators. Analysis of interfacing problems between the transducer and the signal-conditioned signal to the choice of environmental monitoring instrumentation. Prereq: 3120 or 3830.


4630 Digital System Organization and Design (3) Considers system organization of digital systems including minicomputer and microprocessor architectures and comparisons. Characteristics of ALU and CPU structures, storage devices (SRAM, DRAM, and ROM memory), and I/O devices (DMA, interrupt, and I/O building blocks), and input/output systems are developed. Control Unit organization to include timing charts, single-processor operation, asynchronous—asynchronous time sequencing, and microprogramming of control functions. Prereq: 3180. 3-4 labs.

4680 Bioelectric Instrumentation (3) History and origin of bioelectric potentials, transducers, amplifier requirements, recording systems, and noise problems.

4680 Electronic Power Amplifiers (3) Transistor and vacuum-tube power amplifiers: distortion, thermal considerations; r.f. power amplifiers, regulators. Prereq: 3830. 4 labs.

4690 Communications Electronics (3) Oscillation, modulation and demodulation, basic communication systems. Prereq: 3830. 4 labs.

4700 Switching Circuits (3) Pulse amplification, gating circuits, multivibrators, wave shaping circuits, trigger circuits. Prereq: 3010 and 3830. 4 labs.

4710 Integrated Circuits (3) Processing and fabrication of active and passive components for monolithic and hybrid circuits. The design of linear, analog, and digital monolithic and hybrid circuits packaging, reliability, and large scale integration. Prereq: 3920.

4720 Synchronous Machines (3) Development of mathematical models of machines. Applications to analysis of steady state and transient operation. Excitation and governor control system. Stator and rotor design.


4800 Hardware-Software Interface in Mini-computer and Microprocessor System Design (3) Presents minicomputer and microprocessor interface design systems. Prereq: 3830. 4 labs.

4810 Discrete-Data Systems (3) Introduction to the analysis and design of discrete data control systems and frequency domain techniques. Real-time digital signal processing techniques, application of digital computers in closed-loop feedback systems.

4820 Introduction to Pattern Recognition (3) Role of pattern recognition in everyday life and the work of artificial intelligence. Principal topics dealing with the design of learning and adaptive machines. Typical applications of pattern recognition to problems of practical significance. Computer simulation and elementary pattern recognition problems. Prereq: Either 3100 and 3830, or Statistics 3450 and Introduction to Computer Science.


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 4850.)

4910-20-30 Special Electrical Engineering Problems (3, 3, 3) Problems in electrical engineering involving laboratory or research work. 5000 Thesis

5040-50-60 Electrical Engineering Research (3, 3, 3) Research projects in the field of electrical engineering. Prereq: 3040. 4 labs.

5070-50-60 Modern Transform Methods (3, 3) Laplace transforms and complex variable theory. Z-transform, difference equations and distributed parameter systems.


5170 Bioengineering Systems I Models, Systems Analysis and Simulation (3) Modeling techniques applied to biomedical systems. Systems properties of resistance, impedance, and storage are investigated. Analog and digital simulation of biological systems. Prereq: 4370 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 theories in neurophysiology and electrocardiography are investigated. Prereq: 4500 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 the biological system under test and the process by which this information is treated, as to signal analysis and modeling, in order to maximize the yield of meaningful information about the original biological system. Prereq: 4600 or consent of instructor.

5200 Advanced Electrical Machinery (3, 3) Fundamentals of electrical machines, determination of electrical and magnetic field energy conversion; application in conventional devices. Differential equations for rotating machines. Park's theorem and the two-axis model. With emphasis on the transient behavior of isolated and interconnected rotating machines. Prereq: 4780 or equivalent.

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

5240-50-60 Control Systems (3, 3, 3) Analysis and design of continuous and digital control systems using classical and modern techniques. Discussed are feedback theory; system modeling; stability analysis; system response and design; mathematical model of system compensation; etc. Emphasis is placed on the engineering aspects of control systems. Coreq: 3070 or equivalent.

5310 Basic Requirements for Plasma Fusion (3) An historical study of fusion systems in nature. The Lawson break-even criterion. Inertial fusion systems—the hydrogen bomb, laser fusion, and electron-beam fusion. Magnetically-confined plasma systems, including the tokamak, mirror system, and exotic systems. Confinement, stability, and heating. The possibility of fusion-fission hybrids. Prereq: Consent of instructor or plasma engineer; plasma physics background or employment in fusion work.


and those without prior experience in hardware and logic design. Prereq: Elementary linear algebra, statistics, and probability. Includes a laboratory (4 labs/quarter).


5560 Electronic Communication Systems (3, 3) Theory of information transmission in communications systems; mathematical treatment of modulation and demodulation in analog and pulse-type systems. Bandwidth requirements, noise, system performance in noise. All modern systems are considered and compared with emphasis on digital data systems. Prereq: 5610.

5670-80 Introduction to Pattern Recognition (3, 3) (Same as Computer Science 5840-50.)

5690 Introduction to Artificial Intelligence (3) (Same as Computer Science 5820.)

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


5740 Digital Processing of Signals (3) Analysis of discrete systems; sampling theorem and its implication; frequency domain design of digital filters; quantization effects; processing of digital signals; discrete Fourier transform. Prereq: 4570.


5770 System Identification (3) Presentation of various identification schemes including deterministic, stochastic, and hierarchical methods. This course has particular applications in all areas of engineering and science. Prereq: Consent of instructor.

5800 Power Transmission Lines (3) New and unconventional power transmission systems. Transmission line parameters for overhead and underground lines. Corona and radio interference problems in the design of high voltage transmission. Influence of high voltage transmission on coordination and protection. Design procedures for high voltage transmission. Prereq: 4410-20-30 or equivalent.

5810-20 Electromagnetic Fields (3, 3) Vector analysis of static fields, special relativity, plane waves, reflections, waves in anisotropic media, guided waves, rectangular and cylindrical coordinates, transmission lines, waveguide, and frequency elements. Coreq: Math 4510 or 4710.

5830 Linear Antennas and Antenna Arrays (3) The Hertzian dipole, linear antennas, impedances, loop antennas, receiving antennas, linear arrays. Prereq: 5800.

5840 Aperture Antennas (3) Huygens principle, equivalent currents, Fourier transform and vector analysis, diffraction, scattering, formation, lens and reflector antennas. Prereq: 5820.

5850 Microwave Electronics (3) Space charge waves on electron beams, coupling between beams and radio waves, 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, transmitted power, stored energies, propagating and nonpropagating modes, orthogonality properties, boundaries and radiation conditions. Prereq: 5820.


5940-50 Advanced Small Computer Systems (3, 3) Real-time applications, memory and CPU organization, interface software, and peripheral devices of minicomputer and microprocessor system are studied. Courses are project-oriented and supported by hardware and software interface design. Prereq: 4850 or equivalent, consent of instructor. (Same as Computer Science 5940-50.)

6000 Doctoral Research and Dissertation

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

6250 Stochastic Processes in Engineering Systems (3) Analysis and design of systems with stochastic inputs. Methods of batch and sequential estimation; time domain and frequency domain methods of optimum filter design. Prereq: 5900 or equivalent.

6290 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 (3, 3, 3) Advanced problems of current interest are considered for both linear and nonlinear systems. Prereq: 5240-50 and consent of instructor.


6510-10 Electrical Conduction in Gases and Plasma Physics (3, 3) (Same as Physics 6500-10.)


6550 Advanced Antenna Theory (3) Theory of the cylindrical dipole. Hallet's equation, King's integral equation, the integral equation, numerical methods, terminal impedances, and mutual impedance between several dipoles. Prereq: 5610-20 and Math 4520 and 4550.
6660 Electromagnetic Diffraction and Scattering (3) Diffraction of electromagnetic waves by spheres and cylinders, the ground wave propagation problem, introduction to modern approximate methods, creeping waves. Prereq: 5610-20 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, convolutional 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;
A. H. Eraslan, Ph.D. North Carolina State;
J. H. F. Reuter, Ph.D. Iowa State, P.E.;
G. W. Lee, Ph. D. Illinois Institute of Technology;
F. N. Peebles, Ph.D. Tennessee, P.E.; H. Pih,
Ph.D. Illinois Institute of Technology; C. D. Scott, Ph.D. Tennessee; L. R. Shobe,
M.S. Kansas State, P.E.; D. G. Thomas, Ph.D.
Ohio State, P.E.

Associate Professors:
J. E. Akin, Ph.D. Virginia Polytechnic Institute, P.E.; A. J. Baker, Ph.D. New York;
B. R. Davy, Ph.D. Illinois, P.E.; T. G. Curley, Ph.D.
Illinois, P.E., D. A. Hobson, B.S.,
Manoela, P.E. A. Mathews, Ph.D. Illinois, P.E.;
W. A. Miller, Ph.D. Ga. Tech, P.E.; G. J.
Remenyik, Ph.D. Johns Hopkins; W. E. Stillman,
Ph.D. Ohio State, P.E.; J. E. Stoneking,
Ph.D. Illinois; R. E. Tooms, M. D. Tennessee.

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

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/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. In Plan II a minimum of 48 hours is required. The requirements include the following:

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<th>Hours</th>
<th>Credit</th>
<th>Plan I</th>
<th>Plan II</th>
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<tr>
<td>Mathmatics</td>
<td>9</td>
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<tr>
<td>Engineering courses (Major</td>
<td>18</td>
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<td>option: may include but is not restricted to courses offered by the engineering science and mechanics department.)</td>
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<td>Related courses (May include additional courses in mathematics, computer science, or the physical and life sciences as well as engineering courses.)</td>
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<td>Thesis</td>
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ENGINEERING SCIENCE AND MECHANICS

*Engineering courses under Plan II may include advanced laboratory work or special problem work, for example E.S. & 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).

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 Bachelor's 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 6000 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 improvement of his dissertation 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 9 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 not included in the most part at a level and scope expected of well-qualified recipients 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.


3410 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.
4539 Biomechanics (3) Discuss objectives, review foundations and present developments in areas of mechanics of living tissues; biomechanics of injury and prosthesis; material compatibility of prosthetic devices and biomechanics 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 indicative of fracture resistance, including transition temperature, R-curves, stress intensity factors, and J-integrals; the use of these properties in design. Prereq: Mechanics of Materials and Engineering Materials 1, 3 hrs or 2 hrs and 1 lab.

4610 Experimental Stress Analysis (3) Basic concepts; theory, techniques, and instrumentation of resistance strain gages; theory and techniques of the brittle coating method; introduction to other stress analysis methods. Prereq: Mechanics of Materials or Basic Electrical Engineering-Circuits and Fields. 2 hrs and a 3-hr lab.

4720 Dynamic Data Acquisition (4) Instrumentation of measuring systems for dynamic events and responses; signal conditioning; oscillographs, oscilloscopes, and magnetic tape recording; telemetry and data transmission; data reduction; data analysis; 3710, 3700, Elec. Engr. 3120. 3 hrs and a 1-hr lab.


4710 Fundamentals of Vibrations (3) Free and forced vibrations of damped and undamped lumped parameter systems; energy methods. Prereq: Dynamics and 2nd quarter Elementary Linear Algebra and Calculus of Several Variables.


4850 Elementary Structural Matrix Methods (4) Prereq: Mechanics of Materials, Deflections 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

5002 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.

5110-20 Fluid Dynamics (3, 3) Kinematics of fluids, vorticity, rate deformation, plane and axially symmetric stream functions; Navier-Stokes equations in curvilinear coordinates; and boundary-layer approximations; nonviscous flow, potential theory, complex potentials, conformal mapping. Prereq: 5000.

5130 Introduction to Turbulence (3) Macroscale concepts, analogies, statistical treatment, correlation functions, energy spectra, diffusion, and application of turbulent jets and pipe flow. Prereq: 5800.

5182 Finite Element Structural Analysis (3) (Same as CE 5182.)

5220 Mechanics of Viscous Flow (3) Role of viscous forces in the flow of liquids and applications of the Navier-Stokes equations; emphasis on numerical methods of solutions; introduction to laser-opto-ptic methods of laminar flow analysis. Prereq: Math 4610. (Same as Chem. Engr. 5610.)

5230 Non-Newtonian Fluid Mechanics (3) (Same as Poly. Engr. 5230.)


5410-20 Theory of Elasticity (3, 3) Stress, strain in three dimensions; torsion and bending of prismatical bars; axisymmetric stress distribution; stress concentration; plane stress, plane strain. Prereq: 5600.

5430 Thermal Stresses (3) Review of heat conduction; Hookean elastic equations; thermal stresses in beams, rings, plates, and shells; thermal buckling problems. Prereq: 5410 or 5010-20-00, and Heat Transfer.

5440 Theory of Linear Viscoelasticity (3) Introduction to the concepts of linear viscoelasticity of solids; quasi-static problems; vibrations; dynamic problems; stability problems for one- and two-dimensional linear viscoelasticity. Prereq: 5800.


5630-40 Photomechanics (3, 3) Introduction to physical optics, wave motion, polarized light, basic principles of photoelasticity, equipment and techniques, application to two-dimensional elasticity and stress concentration, numerical methods in photoelastic stress analysis, photoelastic coating methods, introduction of three-dimensional photoelasticity. Prereq: Mechanics of Materials, Math 4610, and consent of instructor. 5640: 2 hrs and 3 labs.

5710-20 Advanced Dynamics (4, 3, 3) Physical laws relative to translating and rotating reference frames; rigid body dynamics; variational methods; Lagrange's equations; Hamilton's principle. Prereq: 3710 or 4710, Math 4610.

5730 Advanced Vibrations (3) Vibrations of mechanical and physical systems. Iterative and approximate solutions. Introduction to random vibrations. Prereq: 4710 and 4850.

5740 Vibrations of Continuous Media (3) Equations of motion for strings, rods, beams, membranes, plates, and shells; natural modes and frequencies; response of damped and undamped components to applied dynamic loads; approximate methods of solution. Prereq: 5410 and Math 4550.

5750 Orbital Mechanics (3) Planetary, satellite, and astronomical orbits and trajectories; orbital perturbations; classical principles of minimization. Prereq: 3710 and 4710.

5800 Introduction to Continuum Mechanics (3) An integrated approach to the fundamentals of mechanics of solids and fluids; introduction to Cartesian tensors; stress, deformation, and strain; conservation laws; variational principles; equilibrium equations, applications to solids and fluids. Prereq: Fluid Mechanics and Mechanics of Materials or equivalents.


6910 Special Topics in Engineering Mechanics (3) Selected advanced problems of current interest in mechanics, worked either as a group or individually under direction 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**

**DEGREE**

**Industrial Engineering**

**M.E.**

**M.S.**

**Professors:**

J. R. Buchan, M.S. Georgia Institute of Technology; W. W. Claycombe, Ph.D. Virginia Polytechnic Institute, P.E.; G. H. Huffman, Ph.D. Georgia Institute of Technology; D. H. Pike, E.D. Florida; W. G. Sullivan, Ph.D. Georgia Institute of Technology, P.E.

**Associate Professors:**

W. L. Eaton, M.S. Clarkson, P.E.; M. K. Goodman, M.S. Tennessee, P.E.; T. R. 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, production systems, and advanced design and manufacturing facilities planning and engineering economy. Either one or two minors can be elected in engineering, mathematics, psychology, industrial engineering design electives and economics.

**MASTER OF ENGINEERING PROGRAM**

This professional degree program is intended as a culmination of a five year baccalaureate-master program which emphasizes engineering design and professional practice. Admission requirements include those presented above plus the requirement that the bachelor's degree from an E.C.P.D. accredited engineering program. This 45-quarter hour program requires 18 hours of course work in an industrial engineering core, 8 hours of technical methods electives, 9 hours of industrial engineering design courses and a 9-hour thesis or design project.

**4060 Production and Inventory Systems (3)** Fundamentals and applications of statistical forecasting for production planning, inventory analysis and control, and production planning procedures, economic stock quantity analysis, and production scheduling and control models. The overall production planning process as an integrated system. Prereq: Industrial Operations Research I and Industrial 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, and applying and evaluating standard data methods and incentive systems to the design of industrial work situations. Prereq: Work Measurement, Operations Research I and II.

**4100 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 algorithms, multi-project control, and computer programs. Prereq: Statistics 3450.


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


**4240 Predetermined Time Systems (3)** Work design and measuring using a predetermined time system such as methods time measurement, basic motion time-study, work 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.

**4250 Engineering Economy (3)** Methods and problems in the selection or replacement of equipment. Decisions among engineering alternatives, involving capital recovery, economic life of equipment, and present worth of investment. Not available for graduate credit for industrial engineering students.

**4350 Case Studies in Engineering Economy (3)** Application of the principles of engineering economy 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 economics, etc. Prereq: 4550.

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

**4590 Simulation (3)** Generation of outcome of a complex random process by computer. Models of complex systems using available simulation languages. Simulation as a design tool in industrial systems. Prereq: Computer Science 3150.

**4810 Human Factors in Work Design II (3)** Human capabilities and limitations affecting work place layouts, working environment, design problems. Includes moving and communicating requirements and response in man-machine systems.


5600 Human Factors Engineering (3) Study of the characteristics of man which influence the design of tools, equipment, environments, and products. Participants will be required to model a system of man as a process or system controller. Prereq: Consent of instructor.

5610 Human Factors Engineering (3) The human operator's transfer 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: 4610 or 5600.

5700 Optimization Methods in Industrial Engineering (3) Application of mathematical programming techniques to operational research problems. Algebraic 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: Computer Science 3150 and Matrix Algebra.

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: Computer Science 3150 and Matrix Algebra.

5720 Queuing Models, Inventory, and Simulation (3) Waiting line models and the analysis of inventory systems. Development of simulation methods and computer simulations applied to inventory and waiting line problems. The theory of networks and maximal flow with applications to transportation problems. Prereq: 5700 and 5360.

5730 Game Theory and Random Processes (3) Additional topics in operations research including game theory with applications to decision making in competitive environments and random processes with applications to queuing, inventory models, and decision making. Prereq: 5960.


5830 Health Systems Engineering II (3) Specific functions of health systems are analyzed and evaluated. Control and improvement of the function and the total health system. Prereq: 4830.


5860 Industrial Systems Engineering (3) State variable methods for analysis and design of control and distributed parameter systems. Advanced methods for systems analysis. Introduction to system optimization techniques. Case studies in systems design. Prereq: 4860 or equivalent.

5900 Design Project (1-3) Study of an industrial engineering topic to fulfill the design project requirement in the non-thesis program. Enrollment limited to industrial engineering students. Prereq: Consent of instructor. May be repeated. Maximum 9 hrs.

5910-20-30 Special Topics in Industrial Engineering (3, 3, 3) Special problems for students who are qualified to do individual or group research projects. Prereq: Consent of instructor. May be repeated. Maximum 9 hrs.


6520 Operations Research Models in Engineering Economy (3) Review of traditional capital planning and budgeting techniques. Analysis and application of operations research approaches to decision making. Treatment of problems with emphasis on mathematical programming and computer simulation. Interrelated and potentially conflicting criteria, definition of model choice, and a comparison of appropriate evaluation criteria are considered. Prereq: 5520, 5710.

6700 Nonlinear Programming (3) Development of optimization techniques for static and dynamic nonlinear programs. Applications to various constraints. Emphasis will be given to applying optimization theory to solve nonlinear optimization problems. Topics include variable metric methods, search methods, constrained nonlinear programming, and penalty function methods. Prereq: 5700.

6730 Dynamic Programming (3) Techniques for solving multistage optimization problems as a sequence of single-stage optimization problems. Emphasis will be given to computational as well as the theoretical aspects of dynamic programming. Decision making under certainty and under risk will be considered. Prereq: 5710.

6740 Advanced Topics in Optimization of Dynamic Systems (3) Advanced topics in multistage optimization techniques, including advanced dynamic programming, adaptive optimization theory, and other selected topics. Prereq: 6730.

6790 Advanced Topics in Industrial Engineering (3) Selection of current interest. Topics will cover those not covered in other graduate courses. The course will provide a forum for advanced graduate students to study individually or in a group as appropriate. Prereq: Graduate standing and consent of instructor. May be repeated with consent of department.

6791-690-692 Special Topics in Industrial Engineering (3, 3, 3) Open with consent of instructor. May be repeated.
GRADUATE STUDY PROGRAMS
Graduate programs with specializations in mechanical engineering or aerospace engineering are available which lead to the degrees of Master of Engineering, Master of Science, and Doctor of Philosophy. In addition to the general policies and requirements of the Graduate School each student must satisfactorily complete a program of study which has been approved by the student’s committee. Specific program requirements are given below.

MASTER OF ENGINEERING PROGRAMS
Entrance into the Master of Engineering program is restricted to qualified graduates of ECPD-accredited undergraduate curricula in mechanical or aerospace engineering. At least one-third of the program of study must be classified as engineering design. The student’s advisor will assist in planning the program of study to ensure that it includes the necessary design content.

Three program options (thesis, course, and problems) are described below. Note that some students may not be eligible for the course option.

MASTER OF SCIENCE PROGRAMS
Entrance into the Master of Science programs is available to qualified graduates of recognized undergraduate curricula in mechanical or aerospace engineering and to qualified graduates of other curricula who satisfy the necessary prerequisites. Three program options (thesis, course, and problems) are described below. Note that some students may not be eligible for the course option.

MASTER’S PROGRAM OPTIONS
Three program options are available: 1. The Thesis Option 2. The Course Option 3. The Problems Option

1. The Thesis Option The requirements of this option are that the student must satisfactorily complete a program of study that includes:
   1. 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.
   2. A minimum of nine quarter hours of credit in the field of specialization.
   3. Participation in the departmental seminar programs.
   4. Submission and defense of a written thesis which demonstrates the ability to conduct and report on an independent investigation.
   5. Passing a final examination on all work submitted for the degree.

II. The Course Option 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 committee. The requirements of this option are that the student must satisfactorily complete a program of study that includes:
   1. 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 courses work (4000-level or above) in mathematics. Non more than three quarter hours of engineering course work may be below the 5000 level.
   2. Participation in the departmental seminar program.
   3. Passing a comprehensive written final examination on all course work submitted for the degree. The student's committee will be of sufficient size to include all the study areas reflected in the course program.

III. The Problems Option The requirements of this option are that the student must satisfactorily complete a program of study that includes:
   1. 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.
   2. A minimum of nine quarter hours of credit in Selected Engineering Problems (5900). A written report must be presented for each problem investigated.
   3. Participation in the departmental seminar program.
   4. Passing a comprehensive written final examination on all course work submitted for the degree and an oral examination on all work (including problems) submitted for the degree.

DOCTORAL PROGRAM
Admission into the doctoral program will be granted to those applicants who have demonstrated superior achievement in their engineering backgrounds. 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 or problems.
   2. A minimum of 36 quarter hours of credit in doctoral dissertation.
   3. A minimum of 18 quarter hours in mathematics in courses numbered 4000 or above.
   4. A minimum of 36 quarter hours in mechanical and/or aerospace engineering courses numbered 5000 and above, with at least 12 quarter hours of 6000-level courses. These are exclusive of thesis, problems or dissertation credit.

5. Participation in the departmental seminar program.

GRADUATE CREDIT FOR UNDERGRADUATE COURSES
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. Non-mechanical or non-aerospace engineering 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 associated with energy; primarily for non-engineering students.

3110 Applied Engineering Thermodynamics (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.

3330 Engineering Thermodynamics (3) Properies of gases and mixtures; chemical reactions; equilibrium; applications to mechanical engineering problems.

3410 Fluid Flow (3) Development of continuum, momentum and energy principles for fluid systems; applications to mechanical and aerospace engineering problems.

3440 Heat Transfer (3) Heat transfer processes, heat conduction, thermal radiation.

3520-30-40 Thermal Sciences (3, 3, 3) Fundamentals of thermodynamics and transport phenomena as applied to engineering design. To be taken in sequence.

3610 Mechanics of Machinery—Kinematics (3) Motion of particles, graphical and analytical methods; instantaneous centers; velocities, accelerations.

3620 Mechanics of Machinery—Dynamics (3) Statics and dynamics of structures; statics and dynamics of structures; statics and dynamics of structures.
in material behavior in processing and fabrication, 2 hrs and 1 2-hr lab.

3650 Manufacturing Processes (3) Selection of processes as related to the design of machine parts. Casting, hot and cold forming, metal removal and weldments. Manufacturing tolerances and surface finishes. 2 hrs and 1 2-hr lab.

3910 Engineering Analysis (3) Advanced analysis techniques for problems of aerospace and mechanical engineering. Emphasis on approximate methods.

4140 Energy Conversion Systems (3) Laws governing energy transformations and their application to power plants.

4150 Energy Conversion Systems (3) Operating and design characteristics of new technology energy conversion systems, selected direct conversion techniques.

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.

4170 Turbo-Machinery (3) Basic principles of turbomachinery; systematic methods of analysis, design, performance evaluation.

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.

4420 Heat Transfer (3) Heat transfer by free and forced convection, heat transfer in phase change, heat transfer in high speed flow, heat exchanger applications.

4450 Lubrication (3) Hydrodynamic theory of lubrication of sliding bearings; application of Navier-Stokes equations to infinite and finite bearings; analytical and numerical solutions; applications to design.

4471-91 Experimental Mechanical Engineering (3, 3) Experimental methods and measurement of force, length, time, temperature, pressure, transport rates, and physical properties. Planning, conducting, analyzing, and reporting experiments, running according to test standards and other specifications.

4510 System Dynamics (4) Analytical models of physical systems, linearization, Laplace transforms, dynamic characteristics and stability of systems, numerical simulation, and analog computer solutions. Not for department graduate credit.

4520-30 Creative Design (3, 3) Application of engineering principles to the solution of current problems with emphasis on design innovation.

4621 Manufacturing Processes (3) Comparison of machining methods; plastics production; metrology.

4622 Tool Design (3) Principles underlying tool and fixture design of high-volume production tools and molds, work holding fixtures.


4624 Manufacturing Engineering Systems Design (3) Design of complete manufacturing system 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) Principles of computer and simulation analysis of size and form; true position tolerance theory, tolerance analysis; and workplace control for production to tolerance.

4631 Energy Methods in Mechanical Design (3) Application of strain energy principles in complex beams and structures.

4632 Application of Lagrangian Mechanics in Vibration Problems (3) Generalized coordinates and multiple degree of freedom vibrating systems.

4633 Matrix Analysis (3) Applications of matrices to solution of complex structures and lumped parameter vibrating systems.

4660 Materials and Manufacturing Process (3) Selection of materials in design process, emphasizing relationship between stress and strain analysis, material properties, environment, temperature, manufacturing technology and cost.

4670 Machine Elements (3) Application of strength and properties of materials, design factors, theory of failure to design of machine elements, spring design and shafting, selection of sleeve and rolling element bearings.

4680 Machine Elements (3) Application of strength and properties of materials, design factors, theory of failure to design of cam, gearings, brakes and clutches, selection of chains and belting.

4690 Machine Design (3) Innovative design of complete machine; documentation including specifications, design calculations, working drawings and cost analysis. Written and oral report.

4710 Thermal Environmental Systems (3) Vapor, compression, and absorption cycles; heat pump systems; moist air properties; psychrometric processes.

4720 Thermal Environmental Systems (3) Design and analysis of air washers, cooling towers and extended surface coils; solar radiation; building heat transmission; physiological effects.

4730 Thermal Environmental Systems (3) Design of heating ventilation and air conditioning systems.

4810 Internal Combustion Engines (3) Thermo-chemical phenomena in internal combustion and propulsion engines. Combustion, detonation, equilibrium; dissociation. Analysis of internal combustion engines using ideal and real fluids.

4830 Propulsion Systems (3) Design of propulsion engine and supporting systems.

4910-20-30 Selected Topics in Mechanical Engineering (3, 3, 3) Problems related to developments and practices in mechanical engineering.

5000 Thesis

5002 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.


5120 Convection Heat Transfer (3) Equations of viscous fluid flow, energy equation, convection analysis of internal and external flows including the effects of variable heat flux, surface temperature, and fluid properties. Prereq: 5310 or equivalent.


5140 Phase Change Heat Transfer (3) Prereq: 5120.

5210 Classical Thermodynamics (3) A thorough study of material, energy, and entropy thermodynamics with emphasis on First and Second Law analyses, equilibrium criteria, and the thermodynamics of phase relationships. Prereq: Undergraduate thermodynamics.


5230 Special Topics in Thermodynamics (3) Prereq: Consent of instructor.

5310 Intermediate Fluid Mechanics (3) Vector descriptions in fluid mechanics. Derivation of basic equations; two-dimensional potential flows; viscous flows with emphasis on boundary-layer theory. Prereq: Undergraduate fluid mechanics.

5410-20-30 Research in Mechanical Engineering (3, 3, 3) Design of experiments; data analysis; experimental investigation.

5510-20-30 Mechanical Engineering Design (3, 3, 3) Design of mechanical engineering units and systems.


5510-20-30 Experimental Stress Analysis (3, 3, 3) Theory of elasticity; experimental methods; photoelasticity, strain gages, lacquer coatings.


5760-80-90 Dynamics of Machinery (3, 3, 3) Dynamics of machinery; vibrations; balancing; fly-wheels and governors.

5710 Metal Machining (3) Analytical approach to mechanics of machining. Detailed treatment of basic phenomena; flow, fracture, friction and wear. Prereq: Undergraduate metallurgy 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.

5900 Selected Engineering Problems (3-9) Selected problems in mechanical engineering to fulfill the requirement of the Problems Program. Examination of students in the Problems Program. Prereq: Consent of advisor. May be repeated. S/NC only.
4250 Propulsion (3) Principles of propulsion devices; turbo-jet, ram-jet, and rocket engines.
4260 System Design (3) Synthesis of aerospace system. Design report on the system.
4471-91 Experimental Aerodynamics Engineering (3, 3) Experimental and theoretical investigations of force, length, time, temperature, pressure, transport rates and physical properties. Planning, production, analyzing, and reporting experimental tests run according to test standards and other specifications.
4510 Airplane Performance (3) Introduction to airfoil and wing characteristics, drag; propulsion; static performance and maneuvering; theory and design of control surfaces; stability.
4910 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
5002 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or takes course work.
5110 Fundamentals of Aerodynamics (3) Kinetomastics and dynamics of perfect fluids: potential flow about a body; conformal mappings; hodographs. Prereq: 4220 or ME 5310, Math 4250.
5120 Experimental Methods in Fluid Mechanics (3) Laboratory techniques. Prereq: 4220 or ME 5310. Required for the non-thesis student not otherwise registered during any quarter.
5150-60-70 Air Vehicle Aerodynamics and Performance (3, 3, 3) Application of aerodynamics to air vehicles to provide estimates of performance, stability, and control characteristics. Course work includes: analysis of force, length, time, temperature, pressure, transport rates and physical properties. Planning, production, analyzing, and reporting experimental tests run according to test standards and other specifications.
5210-20 Aerodynamics of Compressible Fluids (3, 3) One-dimensional flow; waves; small-perturbation theory; boundary layer theory; similarity rules; relation of characteristics. Prereq: 4210 for 5210, and 5210 for 5220.
5240 Dynamics of Viscous Flows (3) Equations of viscous flow; laminar and turbulent flow; transition; separation; boundary layer theories; exact and approximate solutions.
5250 Introduction to Hypersonic Flow (3) Blended body flow; similarity; Navier-Stokes theory; blunt body flow; viscous interactions; free molecule and rarefied gas flow. Prereq: 5240.
5250 Selected Topics in Aerodynamics (3) Further study of hypersonic, supersonic and hypersonic flow theories.
5270-80-90 Aerospace Ground Test Facilities (3, 3, 3) Atmospheric models and similarity considerations. Test facilities include wind tunnels, shock tubes, hotshot and ballistic ranges; propulsion test facilities for air breathing and rocket engines. Space environment simulation: meteorological considerations of space environment test facilities. Prereq: 5240, ME 5310 and 8230.
5310 Magnetohydrodynamics (3) Review of electromagnetic theory, chemical kinetics, thermodynamic and thermophysical properties of gas plasmas; governing equations and applications. Prereq: 4240 and Math 4710.
5340-50 Atmospheric Entry (3, 3) Motion and heating along ballistic and lifting trajectories; dynamic stability; controlled reentry systems. Prereq: 5220. Recommended: 5240.
5570 Aerodynamics of Compressible Fluids (3) Introduction to aeroelastic phenomena. Development of the structural and mechanical operators. Stability criteria for airfoils; operating on an oscillating airfoil. Determination of the characteristics of the three-dimensional flutter of wings, control surfaces, and components of the wide flight speed range. Prereq: 4220 and 5520.
5590 Aircraft Performance (3) Energy flow in aircraft, general equations of sound propagation in a nonhomogeneous moving medium; sound waves due to turbulence, vortical sound, pseudosound, propagation and absorption of sound in ducts, instrumentation and measuring techniques. Prereq: Consent of instructor.
5620 Aeronautical Engineering I (3) Special topics and recent research results in the field of aeronautics. Topics to be selected from aeronautical engineering, air traffic control airport-community interface and technological developments and developments pertinent to the present state and future development of air transportation. Prereq: Consent of instructor.
5810 Aviation Systems: An Overview (3) Aviation systems, present and future, analyzed with emphasis upon the systems approach. Consideration of the socio-economic base, aerospace and propulsion technology, meteorology, air traffic control-airport-community interface and technological developments and developments pertinent to the present state and future development of air transportation. For non-aerospace and non-mechanical engineering majors only. Prereq: 5810.
5820 Air Vehicles (3) Current capabilities and future requirements for air transport vehicles. Consideration of parameters significant for air vehicle type selection. Integration of the air vehicle into the aviation system. For non-aerospace and non-mechanical engineering majors only. Prereq: Consent of instructor.
5900 Selected Engineering Problems (3-9) Selected problems in aerospace engineering to further the requirement of the Problems Program. Enrollment limited to students in the Problems Program. Prereq: Consent of advisor. May be repeated.
5950 Seminars (1) Discussions on all phases of aerospace engineering, including reports on
current research at The University of Tennessee, Knoxville. May be repeated, S/IN only.

5990 Special Topics in Aerospace Engineering
Credit to be arranged; 3 hrs maximum each quarter.

6000 Doctoral Research and Dissertation


6320 Magnetohydrodynamics II (3) Continuum magneto-hydrodynamic equations. Alfvén and shock waves, exact solutions for magneto-hydrodynamic channel flows, one-dimensional model of channel flow, the magneto-hydrodynamic boundary layer. Prereq: 6310, Math 5620.

6330 Magnetohydrodynamics III (3) Engineering applications of magnetohydrodynamics with particular emphasis on propulsion and power generation. Prereq: 6320, Math 5630.

6410 Physical Gasdynamics (3) The fundamentals of high-speed, high temperature flow of a gas from the molecular point of view; molecular concepts, simple kinetic theory, equilibrium properties of gases and gas mixtures as obtained from steady-state kinetic theory; chemical thermodynamics, and statistical mechanics. Prereq: 5220 and ME 5220.

6420 Physical Gasdynamics (3) Continuation of 6410; flows of gas mixtures in local thermodynamic and chemical equilibrium; physical and chemical basis of rate equations; flow with vibrational and chemical nonequilibrium. Prereq: 6410.

6610 Advanced Boundary Layer Theory (3) Derivation and critical review of the governing equations. Asymptotic solutions; similarity and methods; boundary layer transformations. Approximate integral methods to include compressibility and heat transfer. Application to attached and separated flows; shock-boundary layer interaction. Prereq: 5220, ME 5410, and Physics 5620.

6910 Advanced Topics in Gasdynamics (3) 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 nonequilibrium transport phenomena, radiation gas dynamics, non-equilibrium gasdynamic flows, advanced kinetic theory, perturbation techniques. Prereq: Consent of instructor.

Nuclear Engineering

MAJOR

DEGREES Nuclear Engineering

M.E., M.S., Ph.D.

Professors:
P. F. Pasqua (Head), Ph.D. Northwestern, P.E.;
W. H. Jordan, Ph.D. California Institute of Technology; P. R. Kasten, Ph.D. Minnesota; T. W. Kerlin, Ph.D. Tennessee; J. C. Robinson, Ph.D. Tennessee; P. N. Stevens, Ph.D. Northwestern, P.E.

Associate Professors:
H. L. Dodds, Ph.D. Tennessee;
J. E. Matt, Ph.D. Minnesota;
J. C. Robinson, Ph.D. Tennessee;
P. N. Stevens, Ph.D. Northwestern, P.E.

Assistant Professor:
L. Miller, Ph.D. Texas A & M, P.E.

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 background courses before he/she 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 9 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 5960, Nuclear Engineering Practice. A student usually registers for 6 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 the work.
3. Final examination covering graduate course work and practical school problems.

MASTER OF ENGINEERING PROGRAM

A graduate program in nuclear engineering leading to the degree of Master of Engineering is available to those graduates with an accredited engineering degree or one which satisfies ECPD basic level criteria.

In addition to Graduate School requirements the following degree requirements must be met:

1. 36 quarter hours of course work, 18 of which must be in nuclear engineering.
2. A minimum of 9 hours of design project, thesis, or Nuclear Engineering 5980, Nuclear Engineering Practice (5980). Documentary proof of significant engineering experience may be submitted in lieu of the design project, thesis or Nuclear Engineering Practice, but in this case 45 hours of course work are required.
3. Nine hours of course work submitted must be from outside of department.
4. A minimum of one-third of the program must be in engineering design, and one-third in one of, or a combination of, advanced math, computer sciences, basic sciences, or engineering sciences.
5. A candidate must pass a final oral examination on all work presented for the degree.

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. The student will be required to demonstrate 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 5000 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/her knowledge in a given field.
6. A reading knowledge of one foreign language will be determined by the student's doctoral committee.

4110-22-30 Introduction to Nuclear Reactor Theory (3, 3, 3) Nuclear structure; radioactive decay laws; neutron interaction; fission processes, chain-reacting systems; vibration equation including multigroup diffusion theory, neutron moderation, reactivity coefficients, perturbation theory. Prereq: Physics 3730 or consent of instructor.

4140-20-30 Nuclear Engineering Laboratory (3, 3) Fusion reactions; properties of plasmas; plasma containment; plasma diagnostics; thermonuclear devices. Prereq: Physics 3730, Math 4550.

4210-22-30 Nuclear Engineering Laboratory (3, 3) Radiation detection and counting instrumentation, counting principles, half-life, decay schemes, gamma spectrometry, cross-section measurements, analog computation, diffusion properties of neutrons, critical leading experiments, control rod calibration, statistical weight, shielding, xenon poisoning, prompt critical reactor behavior, fission assembly and adjoint flux. Prereq or Coreq: 4110 or equivalent.

4550 Reactor Simulation Laboratory (3) Simulation of reactor structure and operation with analog computer; reactor kinetics; single and multigroup theory, reactivity coefficients, poisoning, control rod calibration; power reactor; subcritical assembly. Prereq: 4110.

4610-20-30 Reactor Power Systems (3, 3, 3) Nuclear structure, decay laws, neutron diffusion, time behavior of reactors, host removal, analysis of reactor power plants; economic, safety, and environmental aspects of nuclear power. Prereq: Math 4610, non-nuclear engineering students only.

48 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 mass and energy transport.
4710 Reactor Kinetics and Controls (3) Description of reactor design, integration with non-nuclear systems, economic evaluation; optimization procedures, description of typical systems. Coreq: 4130.

4810 Radiation Shielding (3) Types of radiation sources, gamma ray and neutron attenuation; descriptions of typical systems. Coreq: 4110.

4820 Nuclear Reactor Safety (3) Presentation of reactor safety concepts and criteria; credible accidents; fission product release and transport; containment systems; accident analysis; engineering safeguards. Coreq: 4150. 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: 4193.

5000 Thesis

5002 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.

5110-20-30 Transport Processes in Nuclear Engineering (3, 3, 3) Momentum and heat transport; 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) 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 system dynamics and analysis 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.

5310-20-30 Nuclear Systems Reliability (3, 3, 3) Principles of system reliability analysis as applied to nuclear systems. Both qualitative and quantitative methods are included. Coreq: Stat 3450.

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 ordinates 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. Prereq: 4130 or equivalent.

5740 Reactor Shielding (3) Application of analytic solutions of Boltzman transport equation to shield design problems. Spherical harmonics, moments methods, numerical solutions, adjoint calculations, and invariant imbedding 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. Integration of neutronic, 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 head 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

In some instances two related collateral areas may be selected with nine hours in each area and a minimum of three hours of 5000 courses. (attach.)

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** 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 pro-

* Requirements include Crafts, Interior Design, and Housing 5615 or Child and Family Studies 5170, Child and Family Studies 5720 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 5200.

Consumer studies courses to be selected from Child and Family Studies 5140, 5170, 5190, 5700, 5800, 5900; Crafts, Interior Design, and Housing 6130; Food Science 6040; Textiles and Clothing 5180; Agricultural Economics 4710; Economics 4340, 4320-60; Finance 5210-20; Political Science 5641, 5642-60; Public Administration 5700; Public Policy 5710; Library and Information Science 5750.

Housing courses to be selected from Agricultural Mechanization 5110, 5610; Crafts, Interior Design, and Housing 4320, 5615, 5613-20-30; Planning 5350-80, 5450; Geography 5330.

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 48 hours. Courses may be used to meet more than one requirement but all minimum requirements will need to be met.
Home Economics requires:

Department head not later than the end of the first term in residence.

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 thesis option for the major in consumer studies and housing.

2. Written preliminary examinations.

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 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 5610-20-30-40, 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) and 6000 courses in collateral area 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 and Zoology 5350 (Biometry) or equivalent.

2. Nine hours in a collateral area (upon approval of student's faculty committee) and 6000 courses in collateral area beyond the nine hours may be substituted for 5000 and 6000 courses in nutrition.

3. Minimum of four hours of credit in doctoral seminar.

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 92.

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. A Master's degree 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

MAJORS

Child and Family Studies
Consumer Studies and Housing: Public Policy
Home Economics

DEGREES

M.S.
M.S.
Ph.D.
Ph.D.

Professors:

R. L. Highberger, Ph.D. Iowa; J. L. Kulper (Head), Ph.D. Michigan State.

Associate Professors:

J. L. Cunningham, Ph.D. Michigan State; D. B. Eastwood, Ph.D. Tufts;
V. M. Nordquist, Ph.D. Tennessee; R. M. Swagler, Ph.D. Ohio State.

Assistant Professors:

M. F. Kalinowski, Ph.D. Massachusetts; B. O. Miller, Ph.D. Minnesota;

** Requirements include those listed under the thesis option for the major in consumer studies and housing, plus that 21 hours are needed in consumer studies or housing to include Home Economics 5950 (six hours), or Child and Family Studies 5060 or Crafts, Interior Design, and Housing 5056.
4110 Student Teaching in Preschool Settings (3) Increasing responsibility for planning and guiding groups of young children under supervision of head teacher includes 2 hr weekly seminars, 2 hr observation, 2 hr semester research, Program Planning for Preschool Children, Creative Experiences for Preschool Children, Child Development, Counselor: Student Teaching of Preschool Children.

4210 Family Finance (3) Analysis of alternate ways of meeting financial problems encountered during early family life and consumer economics.

4220 Conserving Time and Energy in the Home (3) Application of 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 Infant Development (3) Development during prenatal period and during first 2 years of life. Prereq: Human Socialization or Human Development, physiology or equivalent.

4260 Adult Development and Aging (3) Adult life in our society. Adjustment to internal and environmental changes through middle and aged years. Prereq: Human Socialization or Family Systems. Human Development or equivalent or consent of instructor.

4350 Advanced Child Development (3) Survey of selected theories relevant to child development, with emphasis on recent theories and research methodology. Prereq: 6 hrs psychology and 6 hrs child development or equivalent.

4400 Learning Experiences with Parents (3) Dynamics of parent-teacher interaction. Emphasis on a variety of techniques for developing an understanding 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. Prereq: Intimate Relationships or Family Development.

4610 Child in the Community (3) Needs of children; community agencies meeting these needs; visits to agencies so parents may become better informed about the welfare of children. Prereq: Human Socialization, Human Development or equivalent.

4620 Administration of Programs for Young Children (3) Planning for the staff, housing, feeding, clothing, health care of infants and young children, school programs, and specialized programs for young children. Prereq: Program Planning for Preschool Children, Music and Literature for Preschool Children, or 4110.

4630 Field Work in Child, Family and Consumer Studies (3) Counseling and teaching experience to work in nursery schools or 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. Prereq: Consent of instructor. May be repeated with consent of department head. Maximum 9 hrs.

4810 Afro-American Families (3) Historical background, sociology and contemporary 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; standardization of goods; grading, branding, labeling; advertising; consumer practices in affecting costs; specific household commodity information. Prereq: Principles of Economics.

5000 Thesis

5052 Non-Thesis Graduate Completion (3) Required for students for whom other courses do not otherwise register them prior to a more advanced research procedure, and who have completed all coursework. May not be used toward degree requirements. May be repeated. S/NC only.

5060 Practicum (1-12) Field experience in selected agencies and organizations that focus on solutions to social problems or that are suited to their experience and future professional needs. Prereq: Consent of instructor. S/NC only.

5140 Consumption and Standards of Living (3) Economic and welfare aspects of consumption. Analysis of factors associated with changes in the standard of living. Prereq: Consent of instructor. S/NC only.

5150 Assessment of Family Behavior (3) Use and interpretation of methods of measurement related to the study of family. Current methodological issues in the study of the family. Prereq: 5410 and 5530 or consent of the instructor.

5160 Management of Time and Energy in the Home (3) Developing and selecting labor-saving methods and devices for the able-bodied and the handicapped. Survey of literature, current trends and methods of research. Prereq: 4220 or consent of instructor.

5170 Consumer Economics (3) Consumer functions in the economy; structure of consumer markets; government action relating to consumers; factors affecting prices of consumer goods.

5180 Family Financial Consultation (3) Analysis of family expenditure patterns, consideration of common financial difficulties, and avenues by which families are assisted. Field experience with consumer consulting services. Prereq: 5170 or 4350 or 5190.

5190 Standards in Consumer Protection (3) Product and performance standards in consumer protection. Theoretical and operational questions relating to standards, including analysis of costs and benefits to consumers. Prereq: 4830, 5170 or consent of instructor.

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) Cultural, social, 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 modern family life; individual adjustments, family relationships. Prereq: Family Development, 4430, or consent of instructor.

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 Families in Crisis (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.

5530 Research Methods in Child and Family Studies (3) Survey of research procedures used in study of child and family behavior; basic methodology of the behavioral sciences. Prereq: Research methods as prerequisite to beginning thesis work in this area. Prereq: 9 hrs child and family studies.

5540 Supervision in Preschool Programs (3) Emphasis on guidance of students working in nursery school and family agencies; analyzing 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/NC 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. Internship in planned parenthood programs and clinic. May be repeated. Maximum 9 hrs.

5840 Family Planning Programs (3) Community and family planning programs. Internship in planned parenthood programs and clinic. 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 and group discussion of topics related to current problems in the areas. Prereq: Consent of the instructor. May be repeated. Maximum 9 hrs.

6310 Individual and Family Development, Psychological Dynamic of Family. Emphasis on the developmental roles of family members' psychological potential, development, and status. The family's contribution to members' psychosocial potential for growth and development and to the realization of human potential. Prereq: 6 hrs in advanced child and family studies, 2 hrs nutrition, 4 hrs physiology, or equivalents.

6320 Individual and Family Development, Cognition (3) Processes through which the human individual learns to recognize his world. Emphasis on the role of active processes involved in development across the life span with focus on research findings and methodology. Prereq: 5210, 5630, 5650, or equivalents.
Ph.D. Pennsylvania State; K. Bates, F.S. Associate Professors: consent of instructor.

of different strategies. Prereq: 5170, 5190 or involved in these efforts and relative success consumer protection legislation. Assumptions standards, information disclosure and other 6720 Consumer Protection (3) Consumer consent of instructor.

dynamic aspects of consumer behavior, in- 6710 Elements of Consumer Choice (3) Analy- sis of consumer decision making, beginning 6700 Consumer Protection (3) Consumer Program deals with the student's 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).

An interdisciplinary program in consumer studies and housing; public policy is available to students with interest in the social science approach to housing. Courses dealing with the design aspects of housing may be elected.

Crafts, Interior Design, and Housing MAJORS DEGREES
Crafts, Interior Design, and Housing Public Policy
Consumer Studies and Housing: M.S. M.S. Ph.D.


Associate Professors: L. M. Mattern, M.S. Iowa State; W. Moran, M.S. Wisconsin.

Assistant Professors: S. Blain, M.F.A. Wisconsin; R. Daehnert, M.F.A. Wisconsin; E. Iverson, M.F.A. Wisconsin; A. K. Farkas, Ph.D. Minnesota.


Graduate students in the area of crafts have a unique opportunity to participate in the summer program at the Pi Beta Phi Arrowmont School of Crafts, Gatlinburg, Tennessee. Instructors at the school are nationally and internationally recognized designer-craftsmen who offer additional experiences planned to explore strengths, structural variability, and form potentials of design. 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 aspect of the 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).

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PI BETA PHI ARROWMONT SCHOOL OF CRAFTS

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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 important only in so far as the experimentation with these contributions 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 aspect of the 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).

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An interdisciplinary program in consumer studies and housing; public policy is available to students with interest in the social science approach to housing. Courses dealing with the design aspects of housing may be elected.
forms in enameling. 5365-Experimentation in the graduate exhibition. 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. 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 weaving 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 in unifying 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 design. 5354—Advanced experimentation using aesthetic concepts in the development of two and three dimensional forms in wood. 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, 4) 5347—Initial development of theory for investigation of aesthetic concepts 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.


5358 Ceramics—Glaze Calculation (4) Experimentation with various types of clay bodies and glazes for reduction and oxidation firing atmospheres. Prereq: Development of techniques and appreciation of instructor. Prereq: Previous work in ceramics and consent of department head. May be repeated. Maximum 8 hrs.

5369 Ceramics—Kiln Construction (4) Investigation of kiln design and construction in 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. Maximum 8 hrs.

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, anthropometry, 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 members. 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.

5613 Housing Management (3) Role and functions of the housing management specialist in dealing with problems of private and assisted housing management. Prereq: 4320 or consent of instructor.

5614 Housing Regulations and Controls (3) Function of regulations and other control practices and mechanics as determinants of the nature, realization, and enforcement of housing in local communities by various user groups. Prereq: 4500 or consent of instructor.

5615 Housing Programs and Policies (3) Analysis of various public and private 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 and Research in planning work center areas such as for kitchens and laundries; evaluation in terms of adequacy, convenience, safety, and costs; problems of installation and remodeling.

5810 Crafts (1-4) Advanced study in crafts. Hours and credit arranged. Prereq: Consent of department head and professor in charge of investigation. May be repeated. Maximum 9 hrs.

5820 Interior Design (1-3) Advanced study in interior design. Hours and credit arranged. Prereq: Consent of department head and professor in charge of investigation. May be repeated. Maximum 9 hrs.

5830 Problems in Housing (1-3) Advanced study in housing. Hours and credit arranged. Prereq: Consent of department head and professor in charge of investigation. May be repeated. Maximum 9 hrs.

5910-20-30 Seminar (1-4, 1-4, 1-4) Hours and credit arranged. Prereq: Consent of instructor.

6110 Contemporary Housing Issues and Problems (3) Critical study and group discussion of various issues and problems related to housing. Prereq: Consent of instructor.

6120 Advanced Topics in Housing Research (3) Examination of contemporary concepts in crafts and interior design. Prereq: Consent of instructor.

6210 Environmental Design Analysis (3) Advanced methodology in the psycho-biology of environmental design with particular attention to multidisciplinary research data and methods. Prereq.: 5510-20-30.

6320 Role of Crafts in Society (3) Comprehensive individual study and group discussion of advanced concepts and current problems in crafts. Prereq: 4310, 5400, 6 hrs of graduate level sociology, or consent of instructor.

6410 Conceptual Development in Craft Design (3) Advanced concepts in the use of visually perceived design elements as demonstrated in handcrafted objects. Prereq: 6 hrs of graduate level psychology, or consent of instructor.

6420 Perspectives in Crafts and Interior Design (3) Historical influences as related to contemporary concepts in crafts and interior design. Prereq: 5640, 6 hrs of graduate level art history, or consent of instructor.

Courses offered periodically only at the Pi Beta Phi Arrowmont School of Crafts at 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)
### Food Science

**Course Details**

**4000** Origin of Food and Foodways (3) Tracing of food and the development of individual and group foodways. Prereq: 6 hrs social science or humanities.

**4010** Introductory Experimental Food Science (5) Use of physical and sensory evaluation in experimentation with fats, high protein foods, and batter and dough systems. Prereq: Nature of Foods II.

**4020** Experimental Food Science (3) Individual experimentation and its relation to the research literature. Prereq: 4010. Recommended: Nutrition 3320.

**4040** Food in Contemporary Society (3) Consumer's options, responsibility and potential influence with respect to food supply.

**5000 Thesis**

5002 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.

**5140 Foods and Nutrition: Physicochemical Principles (3)** Introduction to thermodynamics; physicochemical properties of proteins, carbohydrates and lipids; chemistry of the colloid state; chemical kinetics; specialized kinetics of enzymatic processes. Prereq: Nutrition 3330 and College Algebra or equivalent.

**5150 Food Texture (3)** Classification of foods according to textural parameters; use of instruments in the evaluation of textural characteristics. Prereq: 4010 or Food Technology 4920; statistics; or consent of instructor.

**5250 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.

**5300 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 habits in the individual. Prereq: 4000; 3 hrs of nutrition, or consent of instructor.

**5560 Foodways in the United States (3)** Current foodways and food culture 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 biophysical 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.

**7000 Current Programs 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. 1 lab.

**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 science industry or agency under the supervision of a faculty member. Prereq: Consent of instructor.

**5900 Seminar in Food Science (1-3)** 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 problems in food science. Prereq: Consent of instructor. May be repeated.

**6210 Food Dispersions (3)** Physical characteristics of solutions, colloidal dispersions, and suspensions in relation to treatments applied. Prereq: 5530.

**5150-20 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.

**5510 Food and Socio-Cultural Change (3, 3)** Critical evaluation of factors and interrelationships affecting food intake and consumption. Prereq: 5550 or 5560; or consent of instructor.

**6900 Seminar (1-3)** May be repeated. S/NC only.

### Nutrition

**3310 Organic Chemistry (4)** Emphasis on subjects leading to 3320-3 and Text. and Cib. Prereq: 3350. Prereq: General Chemistry, 3 hrs and 1 lab. Not for graduate credit for food science, nutrition and food systems administration majors.

**3320 Food Analysis (4)** Elementary quantitative analysis; typical food analyses. Prereq: 3310 or equivalent. 3 hrs and 1 lab. Not for graduate credit for food science, nutrition and food systems administration majors.

**3330 Physiological Chemistry (3)** Metabolism of carbohydrates, lipids, and proteins. Role of vitamins and minerals in metabolism. Prereq: 3320 or equivalent. Not for graduate credit for food science, nutrition and food systems administration majors.

**3339 Physiological Chemistry Laboratory (1)** Prereq: 3330. 1 lab. Not for graduate credit for food science, nutrition and food systems administration majors.

**3400 Biochemistry 1 and 2 (3, 3)** Prereq: 6 hrs of nutrition. 2 hrs and 1 lab.

**4010 Reproductive and Developmental Nutrition (3)** Nutritive requirements for expectant mothers, infants, and preschool children. Prereq: 6 hrs of nutrition, 2 hrs and 1 lab.

**4020 Nutrition for Children, Adolescents and Adults (3)** Application of basic principles and research findings to good nutrition for children, adolescents and adults. Prereq: 6 hrs of nutrition, 2 hrs and 1 lab.

**4030 Community Nutrition (3)** Introduction to nutrition problems and services in the community; supervised field experiences are an integral part of the course. Prereq: 6 hrs of nutrition.

**4110 Introduction to Nutrition Research (3)** Discussion of principles and laboratory experiences. Prereq: 6 hours of nutrition, 2 hrs and 1 lab.

**4230 Nutrition in Disease (4)** Nutrition problems in diseases influenced by diet. Prereq: 12 hrs of nutrition and 1 lab.

**4331 Clinical Experience in Dietetics (1)** Planned clinical experiences applying principles of nutrition in disease. Coreq: 4230.
4240 Nutrition in Disease II (3) Interdisciplinary lectures and discussions on the metabolic processes of normal and diseased organs and/or tissues and the dietary or behavior modifications required. Prereq: 4230. Designated for senior students in the coordinated undergraduate program in dietetics.

4430 Diet and Drug Therapy (3) Effect of drug therapy on absorption and utilization of nutrients, and effect of diet on absorption, utilization and toxicity of drugs. Prereq: Science of Nutrition or consent of instructor.

5000 Thesis

5002 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise registered during any quarter when such a student, upon formal application, has completed all course work and has completed a project, paper or report. Credit may be repeated. S/NC only.

5110 Advanced Physiological Chemistry (4) Bioenergetics and related metabolism of nutrients; Prereq: 3330 or equivalent. 3 hrs and 1 lab.

5120 Advanced Physiological Chemistry (3) Nutritional factors in relation to body fluids, gas transport, and enzyme function; Prereq: 3330.

5140 Foods and Nutrition: Physicochemical Principles (3) Introduction to thermodynamics; physical, chemical, and physiological properties of proteins, carbohydrates and lipids; chemistry of the colloid state; chemical kinetics; specialized kinetics of enzymatic processes; Nutrition 3330 and College Algebra or equivalent.


5230 Experimental Methods in Nutrition (3) Use of small animals in experimental nutrition. Prereq: 5 hrs Science of Nutrition. 2 hrs and 1 lab.


5310 Community Nutrition (3) Nutrition problems and practices in the community: supervised field work. Prereq: 5 hrs Science of Nutrition; consent of instructor. 3 labs.

5320 Community Nutrition (3) Observations and participation in nutrition programs of local and state agencies. Prereq: 5310 and consent of instructor. 3 labs.

5330 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.

5340 Field Study in Community Nutrition (1-12) Personal participation in and analysis of a state or regional community nutrition program. Location of the in-depth study to be selected in consultation with the instructor. Prereq: 5320 and consent of instructor. S/NC only. 3 labs.

5350 Mental Retardation or Other Developmental Disorders of Childhood (3) Multidisciplinary core course required of all full-time students enrolled in the Child Development Center, UT Center for the Health Sciences, Memphis. Prereq: Consent of the department head.

5410-20 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.

5430 Physiological Bases for Diets in Disease (3) Developments in the dietary treatment of disease with attention plays a major role. Prereq: 5210 or equivalent.


5450 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.

5460 World Food Supply and Human Nutrition (3) Food supplies and food practices as related 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 requirements, 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 Disorders (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; includes clinical experience and lectures at the Child Development Center, Center for the Health Sciences, Memphis. Prereq: Consent of department head.

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 in charge of investigation. May be repeated. Maximum 9 hrs.

5950-60 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 facilities 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.

4250 Food and Lodging Managerial Cost Control (3) Cost analysis for control. Use of financial statements for decision making for food and lodging systems. Prereq: 4130; Fundamentals of Accounting.

4260 Food and Lodging Physical Plant, Planning and Maintenance (3) Planning, development and construction of food and lodging physical plant and maintenance, Electrical systems, Heating and air conditioning, 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 4250.)

4270 Food and Lodging Information Systems (3) Qualitative and quantitative analysis of information systems for decision making in food and lodging operations. Prereq: 4130, 4250, and Electronic Data Processing.

5000 Thesis

5002 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.

5110-20 Experimental Quantity Food Study (3, 3) Analysis of food production, holding environment, and service problems related to quality of food prepared in volume. Use of management resources. Prereq: 4130, Quantity Food Procurement, Production and Service, or consent of instructor.

5210 Methods of Food Systems Research (3) Research methods applicable to food systems administration. Prereq: 4130, Statistics 5211 or equivalent.

5220 Experimental Design of Food System Facilities (3) Experimental approach to environment in which food is prepared, held, and served in volume. Prereq: 4150.

5230 Food Systems Evaluation (3) Evaluation of management resources in food systems. Standards for control. Prereq: 4130, or consent of instructor.


5310 Administration of Food Service Delivery Systems (3) The role and responsibilities of the administrator in maintaining desired quality and quantity standards in food service delivery system. Prereq: Quantity Food Procurement, Production and Service or consent of instructor.

5350 Clinical Training in Health Care Agencies (3) Instructional and supervised 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) Planned administrative experience in a food systems administration. Prereq: Consent of instructor.

5900 Seminar in Food Systems Administration (1-3) May be repeated.
5110 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.

**Home Economics**

**DEGREE**

**Major**

**Degree**

Ph.D.

**Professors:**

L. M. Osdland (Dean), Ph.D. Wisconsin, D.Sc. Rhode Island; G. E. Goertz (Associate Dean), Ph.D. Kansas State.

**Associate Professor:**

J. L. Cunningham, Ph.D. Michigan State.

**Assistant Professor:**

V. S. Anagnost (Assistant Dean), M.S. Tennessee.

**Practicum (1-12)** Field experience in selected organizations that focus on interdisciplinary solutions to multicultural problems of society. Consent of instructor. May be repeated. Maximum 12 hrs.

**International Studies (1-15)** Student or staff initiated course for study in a foreign country of topic(s) pertinent to field. Topic to be determined by student and instructor with department head and college approval. May be repeated. Maximum 15 hrs.

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 research programs and 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 5540 or Planning 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 instruction. 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 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.

**Textiles and Clothing**

**DEGREES**

**Textiles and Clothing**

Ph.D.

**Professors:**

A. J. Trefee (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. Dowlen, 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 theme in terms of style and color. Prereq: Textiles II; Textile Chemistry, 1 hr and 2 labs.

5000 Thesis

5002 Non-Thesis Graduation Completion (3) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or faculty time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.

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 relating to the textile industry, and individual problems which students have met in the textile field. 2 hrs and 1 lab.

5130 Advanced Tailoring (3) Comparison of historical tailoring and modern 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) As related to human behavior. Prereq: 6 hrs or equivalent from each of the following areas: sociology, psychology, economics.

5180 Advanced Textile Economics (3) Economic problems or problem areas of current importance in the textile and apparel industry; integration of fibers—production, consumption and governmental policy. Prereq: 3420, 6 hours of economics or consent of instructor.

5210 Evaluation of Instructional Materials in the Field of Textiles and Clothing (3) Evaluating instructional materials to use in communicating information in the various areas of textiles and clothing. 1 hr and 2 labs.

5220 Historic Textiles (3) Development of the textile industry in the world with emphasis on fibers used, design and color.

5240 Practicum (1-9) Off campus experience with business, industry, governmental agencies and civic groups; preplanned; supervised. Prereq: Consent of major advisor and department head. May be repeated. Maximum 9 hrs. S/NC only.

5250-60-70 Problems in Textile Chemistry (4, 4, 4) Theoretical and experimental study of chemistry of textile fibers including polymerization, reactions, dyeing, and finishing. 5250 must be taken first. 5260 and 5270 may be taken in sequence. 5250—Emphasis on structure—property relationships and reactions of fibers. 5260—Emphasis on fabric finishes. 5270—Emphasis on dyes and dyeing, 2 hrs and 2 labs. Prereq: 3420 or equivalent, one quarter of organic chemistry.

5310 Fashion Analysis (3) Fashion as a social and economic force; evolutionary theories of fashion operation. Prereq: 6 hrs each of sociology and economics.

5320 Problems in Historic Costume (3) A variable content course with emphasis on the flow of styles in relation to cultural determinants. Prereq: 3480 or consent of instructor. May be repeated. Maximum 9 hrs.

5710-20-30 Current Problems and Trends in Textiles and Clothing (1-3, 1-3, 1-3) Pertinent developments and trends in textiles and clothing and their implications for new types of programs, techniques, TV, and/or curricula approaches. Content and emphasis will vary according to changes in the field and needs of groups serviced. Prereq: Consent of instructor.

5800 Problems in Textiles and Clothing (1-3) Advanced study selected from the field of textiles and clothing. Prereq: Consent of department head and professor in charge of investigation. May be repeated. Maximum 9 hrs.
5900 Seminar in Textiles and Clothing (1-3)
Prereq: Consent of instructor. May be repeated. Maximum 9 hrs.


6110 Selected Issues in Textiles and Clothing (3) In-depth investigation of advanced topics of current significance. Prereq: Consent of instructor. May be repeated. Maximum 9 hrs.

6140 Selected Behavioral Theories in Clothing (3) Role of clothing in the functioning of people, utilizing behavioral theories. Prereq: 5170, 6 hrs of graduate level sociology or psychology, or consent of instructor.

6150 Social-Psychological Theories of Clothing Consumption (3) Analysis and evaluation of social science theories of consumer behavior in relation to the areas of textiles and apparel. Prereq: CFS 5170, 6 hrs of graduate level sociology or psychology, or consent of instructor.

6160 Textile Flammability (3) Factors affecting textile flammability as a consumer issue. Standards, regulations, test methods, economic impact. Prereq: 5120, 5160, 5250, or consent of instructor.

6170 Physical Performance Behavior of Textile Structures I (3) Fundamentals of yarns and fabric structures; relationship of structure to physical characteristics of textile materials. Prereq: 5120, or consent of instructor.

6910 Seminar in Textiles and Clothing (1-3)
May be repeated. Maximum 6 hrs.
Intercollegiate Programs

Aviation Systems

MAJOR DEGREE
Aviation Systems M.S.

Professors:

Associate Professor:
S. N. Chaudhuri, Ph.D. Indian Institute.

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 statistics as represented by Statistics 3450 or equivalent, a basic understanding of aerodynamic fundamentals, aircraft propulsion and performance as represented by A.E. 4110 and A.E. 4120 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, including 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 5610-20-30; 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. 5810.
5080 Collection and Distribution (3) Capabilities, technology, plans, programs and developments for collecting and distributing passengers and freight to and from various types of airports. Ground, water, air and mixed transportation, present and future; requirements analysis, and model analysis of the system. Prereq: A.E. 5810.

5090 Governmental Policies for Aviation (3) Theoretical and legal basis for economic and governmental regulation of aviation. Historical and legislative development of aviation regulatory agencies, organizational structure and administrative and enforcement procedures. Prereq: A.E. 5810.

5100 Project in Aviation Systems (3) In-depth study and formal report on an aviation system 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. Specially equipped airborne 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 flight parameters, 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.

5270 Special Topics in Aviation Systems (3) Current problems in aviation systems. Prereq: Consent of instructor. May be repeated with consent. See also course descriptions for AE 5810, AE 5920, and IE 5840.

Cybernetics and Bionics
Professors: T. C. Helvey (Emeritus), D.Sc. H.C., University of the Atlantic; R. S. Sleeper, M.A. Harvard.*

5110 General Systems and Cybernetics Fundamentals (3) Fundamentals of the theories of cybernetics, bionics, intelectronics, and general systems. Covered 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 the approach to man-machine synthesis. Prereq: 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. Systems aspect of cognition and mental functions, second order interaction in interpersonal communication. Recommended for engineers and persons interested in man-machine interactions.

5990 Cybernetics Seminar (3)

* Space Institute, Tullahoma.

Ecology

MAJOR
Ecology

DEGREES
M.S., Ph.D.

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 locally a spectrum of natural habitats and consequent biological diversity which is truly unique. In addition, faculty members are engaged in 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 100th 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, excluding 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 6000. A student cannot enroll for dissertation until the research proposal has been discussed and approved by the doctoral committee.

Shared Faculty

COURSES
The following courses are those offered directly by the Ecology Program and those which, although listed in other departments, have been approved to satisfy Master's degree requirements. Additional ecology courses are described elsewhere in the catalog under the departments identified in the following list.

Agricultural Biology
4010 Biology of Soil Microorganisms (4)
4510 Freshwater Fishery Biology (4)
4520 Management of Lakes and Ponds (4)

Botany
4310 Plant Ecology (4)
5340 Plant Geography (4)
5350 Analysis of Plant Communities (4)
5510-20-30 Systems Ecology (3, 3, 3)
5830 Field Methods in Plant Ecology (4)

Intercollegiate Programs 99
Industrial and Organizational Psychology

MAJOR

Organizational Psychology

DEGREES

M.S., Ph.D.

Committee:

J. M. Larsen, Jr. (Chairman); R. D. Arvey; R. L. Dipboye; M. E. Gordon; J. M. Louisbury; E. D. Sundstrom; G. H. Whitlock.

(Full Faculty Listing, see Department 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 deficiency (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 (Prerequisite: 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:

   a. Through College of Business Administration:
      Wage and Salary Administration (I.M. 5220)
      Seminar in Personnel Research (I.M. 5240)
      Labor Economics

   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. (I.M. or Psych. 5170, 5180, 5190)

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 the qualifications for pursuing a Ph.D. are required.