Art and Music Education

Charles H. Ball, Head

Art Education

MAJOR
Art Education

DEGREE
M.S.

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

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


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 the Tennessee Certification in art while pursuing the Master's degree program.

The thesis option requires 45 quarter hours as follows:

Quarter hours
1. Art Education 5310, 5320, and electives ............... 18
2. Education Curriculum and Instruction 5710, and electives .. 9
3. Minor (selected with committee) .................. 9
4. Thesis (Art Education 5000) ..................... 9

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

Quarter hours
1. Art Education 5210, 5310, 5320, and electives ............... 21
2. Education Curriculum and Instruction 5800, and electives .......... 9
3. Minor (selected with committee) .................. 9
4. Electives .......................... 6

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 comprehensive 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: 2100. 1 hr and 2 labs.

3930 Textiles in School Program (3) Exploration of processes of weaving, stitchery, balking, and silk screen. Prereq: 2100. 1 hr and 2 labs.

4120 Designing 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: 2100 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: 2100 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: 2100 or consent of instructor. 1 hr and 2 labs.

4160 Appreciation of the Arts in the School Program (3) Prereq: 2100 or consent of instructor. 1 hr and 2 labs.

4530-60-70 Problems in Art Teaching (3, 3, 3) Prereq: Consent of instructor.

5000 Thesis

5002 Non-Thesis Graduation Completion (3-15) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and for any time before degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.

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 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 special student.

5850-80-70 Problems in Art Education (3, 3, 3) Prereq: Consent of instructor.

Music Education

MAJOR
Music Education

DEGREE
M.S.

Professor: C. H. Ball (Head), Ph.D. Peabody; A. W. Humphreys, Ed.D. Illinois; W. J. Julian, Ph.D. Northwestern.


Assistant Professor: M. C. Moore, Ph.D. Michigan.

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 hours), the music education major (18 hours), minor areas in music (9 hours), and professional education (9 hours). Required courses: Music Education 5000, 5210, 5220, 5230; Curriculum and Instruction 5710.

Requirements for non-thesis option:
1. Minimum of 51 quarter hours of course work with a minimum of 26 hours at the 5000 level.
2. Evidence of ability to understand and interpret research through completion of:
   a. Curriculum and Instruction 5610 or equivalent.
   b. Music Education 5710.
   c. Satisfactory performance of research activities in required courses in music education listed below.
3. Curriculum:
   a. A major: at least 27 quarter hours in music education.
   b. A minor: at least 15 quarter hours in music.
   c. 9 quarter hours in professional education, including Curriculum and Instruction 5610 and Educational Psychology 4760 or equivalents and a 3-hour elective.

With the exception of the required courses listed and with approval of the student's advisor, courses may be selected as described more fully above. This provides the flexibility necessary for the student to pursue in some depth specialized interests and needs in the following areas of music teaching:
   1. Elementary; Secondary (Junior and Senior High); Vocal; Choral; Instrumental (Band and Orchestra); and Supervision.
   2. Specific course requirements:
      a. Music Education Foundation (15 quarter hours): (1) One seminar (3 hours) or (2) 5210, Psychological Foundations of Music.
      b. 5240, Evaluation Procedures in Music Education.
      c. 5250, The Role of Music in Education.
      d. 5710, Research in Music Education.
      e. Music: Six quarter hours in applied music (piano; voice; a band or orchestra instrument; or theory and composition). Music (piano; voice; a band or orchestra instrument; or theory and composition).
      f. Education (limited elective of 6 quarter hours): Educational Psychology 4760, Advanced Child Study; or 5050, Children and Adolescents.
      g. 5230 Advanced Classroom Behavior Modification; or any other appropriate course in educational psychology with 3 hours credit.
      h. Electives (with approval of advisor): (a) Music Education: 12 credit hours from courses numbered 5000.
      i. Music: 9 credit hours from courses at the 3000, 4000, or 5000 levels. No courses required in the undergraduate curriculum may be included.
      j. Education: 3 credit hours, elected from other departments in Education.
      k. 6. Evaluation (in addition to routine examinations in courses):
         a. Written comprehensive examination in major and minor fields.
         b. The student shall elect one of the evaluation procedures below (with approval of advisor):
            (1) Oral examinations in major and minor fields.
            (2) A public recital in principal instrument, piano, or voice.
            (3) The presentation in public performance of an original musical composition(s) accepted by the committee as music suitable for school music performing groups.
            (4) 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.
      l. 7. Student's Committee: A minimum of three faculty members—the advisor from music education; one member from music; one member from education.
      m. 4441-42-43 Teaching Class Piano (1, 1, 1) For majors in music, music education, or elementary education. Prereq: Consent of instructor.
      o. 4460 Marching Band Techniques (3) Functions, organization, and direction of a school marching band.

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

5830 Seminar (3) Music teaching in instrumental 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 vocal, theoretical, historical, and appreciation areas of the secondary school curriculum. Research, professional literature and development of bibliography. Laboratory activities. Projects. Prereq: Admission to M.S. program.

Continuing and Higher Education

MAJOR DEGREE

Adult Education M.S.

Professors:
- M. C. McInnis, Jr. (Head), Ph.D. Florida State
- W. H. Coffield, Ph.D. Iowa; J. P. Goddard, Ed.D. Pennsylvania
- E. M. Ramer (Emeritus), Ed.D. Columbia.

Associate Professor:
- K. O. McCullough, Ph.D. Florida State.

Assistant Professor:

The Master of Science degree in Adult Education is offered for teachers, administrators, counselors, and community specialists. The degree program has two options. A thesis option requires 9 hours in the major field, 15 hours of electives, and 4 hours of thesis research. Application differentials are at the discretion of the student's major advisor.

5000 Thesis

5002 Non-Thesis Graduation Completion (3-15) 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 be repeated. S/NC only.

5110 Seminar in College Teaching (3) Effective teaching techniques and teaching of music in secondary school; testing and measurement; research methods. For each option, requires one semester of literature and one semester of research. S/NC only.

52 College of Education

DEGREES

Curriculum and Instruction

MAJORS

Social Science Education

Professors:
- J. Ballif (Head), Ed.D. California (Berkeley);
- J. E. Alexander, Ed.D. Kentucky; C. B. Allison, Ph.D. Oklahoma; E. L. Bronson, Ph.D. Tennessee; P. C. Burns, Ph.D. Iowa; J. N. Chiles (Emeritus), A. M. Missouri; M. A. Christiansen, Ph.D. Kansas; E. A. Christenbury (Emeritus), Ph.D. Georgia; A. R. Davis, Ph.D. Ohio State;
- D. Dessart, Ph.D. Maryland; E. D. Dook, Ed.D. Colorado; H. Franzen, Ph.D. Illinois.

Majors:
- Curriculum and Instruction
- Elementary Education
- English Education
- Foreign Language Education
- Instructional Materials
- Mathematics Education
- Science Education
- Social Science Education

Professors:
- J. Ballif (Head), Ed.D. California (Berkeley);
- J. E. Alexander, Ed.D. Kentucky; C. B. Allison, Ph.D. Oklahoma; E. L. Bronson, Ph.D. Tennessee; P. C. Burns, Ph.D. Iowa; J. N. Chiles (Emeritus), A. M. Missouri; M. A. Christiansen, Ph.D. Kansas; E. A. Christenbury (Emeritus), Ph.D. Georgia; A. R. Davis, Ph.D. Ohio State;
- D. Dessart, Ph.D. Maryland; E. D. Dook, Ed.D. Colorado; H. Franzen, Ph.D. Illinois.

Curriculum and Instruction
According to a plan jointly developed by the student's committee, the degree may be exempted from a thesis if the student has written a thesis for the Master's degree in the College of Education. The thesis must follow the student's major area.

The Doctoral Program

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

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

THE DOCTORAL PROGRAM

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

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

THE MASTER'S PROGRAM

For the Master of Science degree, thesis and non-thesis options are available in the following majors: Curriculum, Elementary Education, English Education, Foreign Language Education, Instructional Media and Technology, Mathematics Education, Science Education, or Social Science Education. The non-thesis option requires the completion of 51 quarter hours of course work.

THE SPECIALIST PROGRAM

The Educational Specialist degree program with a major in Curriculum and Instruction will encompass concentrations in the following areas: Curriculum, Elementary Education, English Education, foreign language education, instructional media and technology, mathematics education, science education, social science education.

The program includes a minimum of 60 quarter hours of graduate study. If the student has earned the Master's degree, a maximum of 45 hours of the Master's work may be credited to the 90-hour Ed.S. requirement. (45 hours of 5000-level courses are required.) The program must also include the following:

1. A minimum of 12 hours taken in courses 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 9 hours earned through the writing of a thesis. (Students who have written a thesis for the Master's degree may be exempted from a thesis in the Ed.S. program provided, in the judgment of the student's committee, the thesis meets the standards of research appropriate for the Ed.S. degree.)
5. A minimum of 45 elective hours taken according to a plan jointly developed by the student and the major professor in terms of the student's professional goals.

THE DOCTORAL PROGRAM

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

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

THE MASTER'S PROGRAM

For the Master of Science degree, thesis and non-thesis options are available in the following majors: Curriculum, Elementary Education, English Education, Foreign Language Education, Instructional Media and Technology, Mathematics Education, Science Education, or Social Science Education. The non-thesis option requires the completion of 51 quarter hours of course work.

THE SPECIALIST PROGRAM

The Educational Specialist degree program with a major in Curriculum and Instruction will encompass concentrations in the following areas: Curriculum, Elementary Education, English Education, foreign language education, instructional media and technology, mathematics education, science education, social science education.

The program includes a minimum of 60 quarter hours of graduate study. If the student has earned the Master's degree, a maximum of 45 hours of the Master's work may be credited to the 90-hour Ed.S. requirement. (45 hours of 5000-level courses are required.) 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 9 hours earned through the writing of a thesis. (Students who have written a thesis for the Master's degree may be exempted from a thesis in the Ed.S. program provided, in the judgment of the student's committee, the thesis meets the standards of research appropriate for the Ed.S. degree.)
5. A minimum of 45 elective hours taken according to a plan jointly developed by the student and the major professor in terms of the student's professional goals.

THE DOCTORAL PROGRAM

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

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

THE MASTER'S PROGRAM

For the Master of Science degree, thesis and non-thesis options are available in the following majors: Curriculum, Elementary Education, English Education, Foreign Language Education, Instructional Media and Technology, Mathematics Education, Science Education, or Social Science Education. The non-thesis option requires the completion of 51 quarter hours of course work.

THE SPECIALIST PROGRAM

The Educational Specialist degree program with a major in Curriculum and Instruction will encompass concentrations in the following areas: Curriculum, Elementary Education, English Education, foreign language education, instructional media and technology, mathematics education, science education, social science education.

The program includes a minimum of 60 quarter hours of graduate study. If the student has earned the Master's degree, a maximum of 45 hours of the Master's work may be credited to the 90-hour Ed.S. requirement. (45 hours of 5000-level courses are required.) 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 9 hours earned through the writing of a thesis. (Students who have written a thesis for the Master's degree may be exempted from a thesis in the Ed.S. program provided, in the judgment of the student's committee, the thesis meets the standards of research appropriate for the Ed.S. degree.)
5. A minimum of 45 elective hours taken according to a plan jointly developed by the student and the major professor in terms of the student's professional goals.
5282 Teaching Science in the Elementary School (3) Trends, issues, and research in content and method for elementary program.

5283 Programs and Materials in Teaching Elementary Science (3) Analysis of new and innovative science program materials, instructional strategies inherent in teaching of 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: 5282 or equivalent, or consent of instructor. At least 1 yr teaching experience (K-8).

5280 The Teaching of Mathematics in the Elementary School (3) Trends, issues, and research in content and method for mathematics program, grades 1-8. Prereq: 3350 and Mathematics 2110-2430 or consent of instructor.

5291 Programs and Materials in Elementary School Language Arts (3) Programs and special instructional aids associated with language arts. Prereq: 5280 or equivalent, or consent of instructor.

5292 Seminar in Research and Theory in Teaching Mathematics in the Elementary School (3) Systematic study of research and the application to teaching of mathematics. Prereq: 3350 or equivalent, consent of instructor, and 1 yr of teaching experience.

5302 Psychology of Reading (3) The reading act, relationships between learning theory and teaching, role of reading in child's overall intellectual development. Prereq: Undergraduate reading course or consent of instructor.

5304 Programs and Materials for Reading Instruction (3) Examination, selection, and use of materials in reading program, distinguishing between content and materials for teaching reading. Prereq: 3281 or 4300 or consent of instructor.

5305 Trends and Issues in Teaching Reading (3) Critical analysis of new programs, materials, innovations, and developments in reading. Prereq: An undergraduate course in reading or consent of instructor.

5306 Teaching Reading to the Linguistically Dif- ferent Learner (3) Language characteristics and special reading problems pertaining to linguistically different learner. Prereq: Undergraduate reading course or consent of instructor.

5307 Assessment and Correction of Classroom Language Arts Difficulties (3) Classroom approaches to assessing and correcting language arts (other than reading) difficulties. Prereq: 5040 or 5280.

5350 Curriculum Development and Evaluation (3) 5360-70 Curriculum Development in the Local School (3, 3)

5365 Mathematics Laboratories in Elementary School (K-8) (3) For elementary school teachers dealing with activity-oriented mathematics laboratory materials and pedagogical strategies. Theoretical considerations and development of curricula and materials for laboratory. Prereq: Consent of instructor.

5380 Diagnosis of Remedial Reading Problems (3) Prereq: 4300.

5381 Remediation of Remedial Reading Problems (3) Prereq: 5380 or consent of instructor.

5382 Developmental Reading Practicum (3) Diagnosis 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)
5825 Teaching Mathematics in the Middle and Junior High School (3) Problems related to teaching and learning mathematics in middle and junior high schools. Understanding structure of mathematical concepts, strategies, methods, and materials at appropriate levels for instructional teaching and learning. Prereq: 3270 or 3280 or equivalent.

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

5835 Teaching Mathematics in the Senior High School and Community/Junior College (3) Curriculum and teaching problems. Methods of teaching, "analysis" courses such as Algebra II, trigonometry, analytic geometry and calculus. Prereq: 3751-52 or equivalent.

5841 Trends and Issues in Early Childhood (3) Historical background, trends, and issues as basic to enquiring and improving programs; materials and techniques of teaching.

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

5843 Seminar in Early Childhood Education (3) Analysis of research in early childhood education (K-3) with emphasis on application to programs and methods of instruction. Prereq: 5710 or 5800 or equivalent.

5844 Mathematics in Early Childhood Education (3) Behavioral characteristics of children in regard to mathematics, content materials and functional instructional settings, and teaching strategies for development of mathematical ideas. Prereq: 3350 or equivalent.

5845 Social Studies and Science in Early Childhood Education (3) Integrative approaches to and substantive classification systems of content areas of social studies and science for early childhood years. Emphasis on selection of appropriate social studies and science content and approaches for the young child. Prereq: 3270 and 3720 or equivalent.

5846 Language Arts in Early Childhood Education (3) Integration of language arts in meeting needs of young learner through teaching methods, procedures, programs and materials in early childhood language arts. Prereq. 3280 and 3280-81 or equivalent.

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

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

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

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

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

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

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

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

5858-68-79 Problems in Education: Conservation (3, 3, 3)

5899 Field Experience (1-3) Application of curricular and instructional principles, methods, and materials in schools. Program prerequisites must be met, and consent of instructor required. May be repeated. Maximum 12 hrs. S/N/C only.

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 The Teaching of Mass Media in the English Classroom (3) Nature of mass media and importance to American education and life.

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

5906 Teaching Poetry in Grades 7-12 (3) Materials and strategies for teaching poetry.

5907 Teaching Drama in Grades 7-12 (3) Strategies and materials for teaching drama.

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

5909 Instructional Theory and Design (3) For those individuals interested in learning who have interest in intensive study of 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.

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

5960 The Teaching of Natural Science (3) Teaching strategies, testing and evaluation techniques, and professional guidelines for program planning in science.

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

5970 The Teaching of the Social Studies (3)

5980 Projects, Programs, and Materials in Social Studies (3) Readings and aids associated with each social science discipline.

6000 Doctoral Research and Dissertation

6010 Studies in English Education (3) Reading and study in various areas of 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) Research and theory in application to teaching of reading; research design as it applies to reading investigations. Prereq: Two 5000-level courses in reading.

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

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

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

6080 Advanced Seminar in Philosophy of Education (3) Some selected philosophical issues in education. Prereq: At least 2 courses in history or philosophy of education.

6081 Phenomenology and Education (3) Selected philosophical issues. Prereq: 5710. At least 2 courses in history or philosophy of education.

6082 Philosophical Analysis and Education (3) Philosophical analysis of language and concepts in educational research and writing. Prereq: At least 2 courses in history or philosophy of education.

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

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

6220 Programs for Curriculum Improvement (3)

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

6282 Advanced Studies in Elementary School Science (3) Critical analysis of current research in elementary school science. Prereq: Undergraduate course and one graduate course in science, or equivalent.

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

6400 The Dynamics of Educational Change (3) Causes of lag between educational theory and practice; factors useful in reducing this lag.

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

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

6710 Advanced Educational Statistics (3)

6720 Interpretation of Data (3) Types of data 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 elementary and secondary school. Prereq: 5270 or 5410 or equivalent.

6731 Studies in Curriculum Theory and the Structure of Knowledge (3) Philosophy, 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 inInstructional Improvement (3) Observation and participation in workshops sponsored by College of Education; evaluation of workshop approaches to teacher 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 United States providing broad perspective on current curriculum problems and future trends. Prereq: 5830 or consent of instructor.

6850 Principles of Educational Leadership (3) Conflicting concepts, with application to major problems in instruction, supervision, and administration.

6899 Internship (1-3) Advanced level experience in application of principles and practices of curriculum development and instructional improvement. Program prerequisites must be met and consent of instructor required. May be repeated. Maximum 12 hrs. S/N/C only.
Educational Administration and Supervision

MAJOR

Introduction to Educational Management (1)

Education Administration and Supervision (3)

Introduction to Educational Management (1)

DEGREES

M.S., Ed.S., Ph.D.
Ed.D.

Professors:

D. H. Stollar (Head), Ph.D. Ohio State;
C. M. Peccolo, Ph.D. Iowa; R. K. Roney, Ed.D. Tennessee; C. K. Tanner, Ed.D. Florida State;

Associate Professors:

H. F. Aldmon, Ed.D. Tennessee;
G. W. Harris, Jr., Ph.D. Michigan; P. M. Husen, Ed.D. Stanford.

Programs are planned for (1) students preparing for administrative positions normally found in the educational structure of the state; (2) students preparing for the position of supervisor of education; (3) administrators and supervisors in service who wish to improve their professional competence; (4) students and teachers preparing for teaching positions involving administrative responsibilities; and (5) students preparing for teaching educational administration or for administrative positions in higher education.

In addition to M.S. and Ed.D. degrees, a special two-year graduate program is offered which leads to the Ed.S. (Supervision) degree and which provides advanced preparation for applicants judged to be potentially competent school administrators.

5000 Thesis

5002 Non-Thesis Graduation Completion (3-15)

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.

5100 Internship in Educational Administration (3)

May be repeated with consent of department. Maximum 6 hrs.

5110 Introduction to Educational Administration (1)

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

5220 Philosophy and Theory in Educational Administra-

5220 Seminar in the Behavioral Sciences for Educa-

5290 The Politics of Education (3) Special emphasis on leadership structures, operational beliefs, and communication of ideas with regard to community decisions concerning education.

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

5420 District Level Administration (3)

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

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

5450 Organization of the School Program (3)

5470 Introduction to School Facility Planning (3)

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

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

5530 Introduction to Educational Planning (3)

5580 Analysis and Interpretation of Research for Educational Administrators (3)

5580 Seminar in Communication Skills for Educational Administrators (3)

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

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

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

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


5720 Seminar in Urban School Administration (3)

5730 School Business Management (3)

5740 School Law (3) Constitutional provisions, special legal interpretation of Tennessee law affecting educational administration.

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

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

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

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

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

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

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

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

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

5770 Maintenance of School Plants (3)

5780 Supervision (3) Supervisory activities of county and city school supervisors. Use of committees, effective techniques for working with groups, relationships with local and state administrators, and supervisory personnel, and techniques for evaluation of supervisory programs.

5790 School Board-Supervisor Relationships (3)

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

5830 Contemporary Economics and Educational Finance (3)

5890 Decision Making and Decision Theory in Educational Organizations (3) Theoretical constructs underlying executive decision making; direct application of decision theory problem-solving activities; and the function of the supervising administrator. Executive decision making at several administrative levels in complex educational organization. S/NC only.

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

5980 Administration in Higher Education (3)

5981 Specialized Seminar: School Operation (3)

5982 Specialized Seminar: Higher Education (3)

5983 Specialized Seminar: State School Administration (3)

5984 Specialized Seminar: Preparation Programs (3)

5981 Specialized Seminar: Theory (3)

5982 Specialized Seminar: Finance (3)

5984 Specialized Seminar: Business Management (3)

5995 Specialized Seminar: Personnel (3)

5998 Specialized Seminar: School Law (3)

6000 Doctoral Research and Dissertation

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

6100 Internship in Educational Administration (3)

May be repeated at discretion of student’s committee. Opportunity for doctoral students and advanced graduate students to gain experience in performance of critical tasks of educational administration under supervision of practitioner and University representative.

6210 Modern Trends in the Theory and Practice of Educational Administration and Supervision (3)

6220 Programs for the Professional Preparation of Educational Administrators and Supervisors (3)

6460 School Personnel Administration (3) Personnel administration functions for professional and supporting staff in educational organizations. Recruitment, selection, placement, personnel policies, employees’ wage and salary administration, fringe benefits, collective bargaining, and staff evaluation.

6480 Special Topics in School Personnel Administra-

6570 Maintenance of School Plants (3)

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

6750-50-70 Independent Studies in Educational Administration and Supervision (3, 3, 3) Prereq: Consent of instructor.

6800 Administration of Complex Educational Or-

6870 Advanced Study in School Facility Planning (3)

6990 Specialized Doctoral Seminar in Politics of Education (3) Political theories and practices as they affect operation of public school systems. Appropriate interdisciplinary discussions based on literature and research from education, sociology, and political science. One field inquiry.
Schools (3) Prereq: 2430 or equivalent.

4130 Mental Health (3) Studies and exploration of the role of education in these changes. For student search base, of factors which contribute to sex and/or sex differences. Prereq: 4130 or basic course in psychology; credit not given for both courses.

1, 2, 2) (Same as Psychology 5149-59-69.) SINC only.

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

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

5210 Interpreting Published Articles: Statistics (3) Descriptive and experimental research in educational psychology, guidance and counseling, and public higher education. Student discipline, housing, dress, organizations, activities, fees, tuition, and related federal regulations. (Same as Continuing and Higher Education 5420.)

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

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

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

5780 Career Development: Theory and Research (3)

5785 Career Development: Program Development, Implementation, and Evaluation (3) Career development and prevocational programs and projects; K-adult with emphasis on development, implementation, and evaluation. Prereq: 5780 or equivalent, or consent of instructor.

5790 Career Development: Workshop (1-6) Designed for in-service training of school personnel. Developmental programs, problems, and projects related to career development. May be repeated. Maximum 6 hrs. (Same as Curriculum and Instruction 5790 and Special Education 5790.)

5840 Student Appraisal (3) Gathering, interpreting, and using data for development of guidance programs and individual counseling. Prereq: Educational Psychology or Psychology 4640 or equivalent in standardized testing. (Same as Psychology 5840.)

5850-60-70 Special Topics and Problems in Educational Psychology and Guidance (1-6, 1-6, 1-6)

May be repeated. SINC 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.
6910 Special Topics Seminar (3) Exploration of specific research or theoretical topics with students who have necessary background. Topic will vary from quarter to quarter, depending upon instructor. Prereq: Permission of department as doctoral student. May be repeated. S/NC only.

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: 5690 and consent of instructor.

6945-46 Teaching Practicum in Educational Psychology and Guidance (3, 3) Prereq: Acceptance in doctoral program and consent of instructor.

6950 Counseling Supervision (3) May be repeated with consent of advisor. Prereq: 5690, 5940, 6160, 6841. S/NC only.

Special Education and Rehabilitation

MAJORS

Special Education

DEGREES

M.S.

Vocational Rehabilitation Counseling

M.S.

Instructors:


Practicum in College Student Personnel (3) Prereq: 5599-60-70 or consent of instructor. May be repeated with consent of instructor. Maximum 9 hrs.

9000 Doctoral Research and Dissertation

8040 Seminar in Educational Psychology and Guidance Required 3 quarters.

8089 Internship (1-2) Supervised employment at departmentally-approved internship sites. Prereq: Consent of instructor. May be repeated. Maximum 12 hrs. S/NC only.

6110 Application of Research Design in Educational Psychology and Guidance (3) Research design and statistical analysis unique to educational psychology, counseling, and college student personnel. Emphasis on designs "experimental" in nature. Prereq: 2 courses in statistics or consent of instructor.

6120 Application of Experimental Research Design in Educational Psychology and Guidance (3) Experimental designs used by researchers in educational psychology, counseling, and college student personnel. Under the sponsorship of Social and Rehabilitation Services, a special program in special education is provided.

6139 Field Work in School Psychology: Level II (2) (Same as Psychology 6319.)

5650-60-70 Seminar in College Student Personnel (2, 2) Issues in 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 Dissertation Proposal Writing (2, 2, 2) Preparation and evaluation of dissertation proposals. Prereq: Two consecutive statistics courses or consent of instructor.

6850-60-70 Systems Approaches in Psychological Services (3, 3, 3) (Same as Psychology 6950-60-70.)

6859-69-79 Practicum in School Psychology III (2, 2, 2) (Same as Psychology 6859-69-79) S/NC only.

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

6810 Seminar in Counseling (3) Selected counseling theory, topics, issues. Prereq: 5890 or consent of instructor. May be repeated.

6840-59-60 Seminar in Professional Issues (1, 1, 1) Job selection, convention participation, publication, techniques in tests, seminars, consulting, etc. For final year doctoral students only.
5220 Linguistics in the Education of the Hearing Impaired (3) Recent research and developments in language therapy for hearing impaired.


5280 Seminar on Educational Implications of Language Deficiency (3) Readings, discussion, and related exercises on impact of language in educational programming for children with language deficiency.

5310-20-30 Manual Communication (2, 2, 2) Basic and advanced skills in American Sign Language. Signed forms of communication. Emphasis on ability to express and receive the manual forms. Prereq: Consent of instructor. Must be taken in sequence.

5400 Educational and Vocational Guidance of the Deaf and the Hard of Hearing (3) Evaluation; test techniques for diagnosis and guidance; social and personality adjustment; occupational opportunities.

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

5820 Curriculum Development Applied to Programs for Hearing-Impaired (3) Current curriculum trends adapted for hearing impaired individuals. New curriculum options in education of these children. Current education theories for programs for hearing-impaired children. Prereq: Curriculum and Instruction 5580 or equivalent and consent of instructor.

EDUCATION OF THE MENTALLY RETARDED

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

4120 Education of the Mentally Retarded Child (3) Philosophy and rationale underlying teaching and guidance of mentally retarded; methods and materials in special and regular classes. Prereq or coreq: 4110.

4440 High School Program for the Mentally Retarded (3) Core and work study programs. Prereq: Consent of instructor.

4810 Student Teaching Mental Retardation (3) Prereq: Major in education of mental retardation. S/NC only.

4811 Student Teaching Mental Retardation (9) Individual tutoring and classroom observation and teaching. Prereq: Consent of instructor.

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

4924 Student Teaching of the Educable Mentally Retarded (9) Observation and supervised practice. Prereq: Consent of instructor.

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

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

5113 Advanced Curriculum for the Mentally Retarded (3) Philosophy and rationale underlying teaching and guidance of mentally retarded children and adults. Emphasis on varied curricula for training/education of mentally retarded children. Multiple Disabilities

4130 Education of the Brain-Injured Child (3) Nature of brain-injured child; skills for indentifying educational, physical, and emotional characteristics. Prereq: Consent of instructor.

4150 Education Problems of Hospitalized and Homebound Children (3) School and home responsibilities for physical care and social relation-
5403 The Public School Speech and Hearing Program (3) Organization, administration, and procedures.
4040 Appraisal of Speech and Language Disorders (4) (Same as Audiology and Speech Pathology 4040.)
4310 Stuttering (3) (Same as Audiology and Speech Pathology 4310.)
4320-30-40 Clinical Practice in Speech Pathology (1, 1, 1) (Same as Audiology and Speech Pathology 4320-30-40.)
4341 Clinical Practice in Speech Correction in the Public Schools (3) Prereq: 4030, 4320-30-40 and consent of instructor. S/NC only.
4342 Seminar in Speech Correction in Public Schools (3) Prereq: 4030, 4320-30-40 and consent of instructor.
4400 Voice Disorders (4) (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 (4) (Same as Audiology and Speech Pathology 4720.)
4930 Aural Rehabilitation: Speechreading and Auditory Training (4) (Same as Audiology and Speech Pathology 4930.)
4940 Advanced Aural Rehabilitation (4) (Same as Audiology and Speech Pathology 4940.)
5040 Advanced Clinical Practice in Audiology Study and Practice (1-4) (Same as Audiology and Speech Pathology 5040.)
5380 Cerebral Palsy (3) (Same as Audiology and Speech Pathology 5380.)
5390 Cleft Palate (3) (Same as Audiology and Speech Pathology 5390.)
5540 Seminar in Language Pathology (3) (Same as Audiology and Speech Pathology 5540.)
5650 and 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.
5560-70 Problems in the Education of Exceptional Children (3, 3, 3)
5620 Counseling Parents of Exceptional Children (3) Interpreting exceptionalities (handicapped and gifted), personal adjustment and acceptance of the child in school/home.
5790 Career Development: Workshop (1-8) (Same as Audiology Psychological 5790.)
5910-20-30 Problems in Lieu of Thesis (3, 3, 3)
5970 Juvenile Delinquency and the School (3) Responsibilities of school in studying sources of maladjustment; school function in community programs for children's welfare; curricular adjustments; directed study of socially maladjusted children, environment, and programs for meeting needs.

Vocational-Technical Education

MAJORS

DEGREES

Agricultural Education M.S.
Business Education M.S., M.ACT
Distributive Education M.S.
Home Economics Education M.S.
Industrial Education M.S.
Vocational-Technical Education M.S., Ed.S., Ed.D.

Professors: J. E. Neary (Emeritus), Ph.D. Ohio State.
Industrial Education: R. W. Haskell, Ph.D. Purdue; J. L. Reed (Chairperson), M.S. Oklahoma.

Associate Professors: W. A. Cameron, Ph.D. Ohio State; D. M. Miller, Ed.D. Oregon State; A. L. Higginbotham, Ph.D. Ohio State; S. M. Smith, Ph.D. Ohio State; G. E. Smith, Ph.D. Ohio State; J. M. Fraser, Ph.D. Ohio State; S. W. Miller, Ph.D. Ohio State;


THE MASTER'S PROGRAM

Each vocational service area (agricultural education, business education, distributive education, home economics education, industrial education and vocational-technical education) offers similar programs leading to the Master's degree. Both thesis and non-thesis options are available. Details regarding the Master's programs of each of the service areas may be obtained from the chairpersons of the different services. The MACT is also available in the business education area.

THE SPECIALIST PROGRAM

The Ed.S. degree program, which is a thesis or non-thesis program, is a cooperative undertaking involving all vocational service areas. Options are available in agricultural, business, distributive, and industrial education and in general vocational-technical education.

THE DOCTORAL PROGRAM

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

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

4750 Utilization of Instructional Media (3) (Same as Curriculum and Instruction 4750 and Library and Information Science 4750.)

5000 Thesis

5002 Non-Thesis Graduation Completion (3-15) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or faculty time. Bachelor's degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.

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


5270 Placement, Follow-up and Evaluation Procedures in Occupational Education (3) Methods and procedures in establishing placement programs, job analysis, and curriculum revision in occupational education.

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

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

5350-60-70 Problems in Vocational-Technical Education (1-6, 1-6, 1-6) May be repeated. Maximum 9 hrs.

6000 Doctoral Research and Dissertation

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

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

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

6230 Evaluation of Vocational-Technical Education Programs (3)

6310 Administration of Vocational-Technical Education (3) Administrative principles and relationship to vocational and technical training.

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

Agricultural Education

4510-20-30 Problems in Agribusiness Education (1-6, 1-6, 1-6) May be repeated. Maximum 9 hrs.

4710-20-30 Seminar in Agricultural Education (1, 1, 1) Prereq: 4350 or consent of department head.

5000 Thesis

5002 Non-Thesis Graduation Completion (3-15) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or faculty time. Bachelor's degree is completed. May not be used toward degree requirements. May be repeated. S/NC only.

5011-12-13 Graduate Seminar: Current Problems in Business Education (1, 1, 1) Required 3 consecutive quarters during residency. S/NC only.

5120 Graduate Seminar in Tests and Measurement (3)

5130 Graduate Seminar in Guidance (3)

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

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

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

5511-21-32 Problems in Business Education: Typing (3, 3, 3)

5623-33 Problems in Business Education: Bookkeeping and Accounting (3, 3)

5614 Methods and Materials for Vocational Office Education (3) Methods and materials for vocational office education programs. Development of instructional aids, recent developments and research, individualized instruction, and occupational clusters for VOE.

5624 Problems in Business Education: Clerical Practice (3)

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

5618 Organization and Management of Vocational Office Education Program (3) Developing occupational clusters, guidelines in cooperatives, laboratories, and model office programs. Physical facilities, instructional aids, related instructional activities (clubs), enrollment, instructor and advisory committee.

5628 Problems in Business Education: Administration (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 as these areas affect the distributive education curriculum in secondary and postsecondary programs.

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

4210 Organization and Operation of Distributive Educational Programs (3) Background and development needs, federal and state legislation; cur-
program in 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 preparing for supervisory positions in vocational education. Program planning, organization, administration. Field contacts with urban and rural programs.

5820 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

5110 History and Philosophy of Industrial Education (3)

5210-20-30 Part-Time Programs in Cooperative Industrial Training (3, 3, 3) Principles of organization, methods, and materials.

5310 Shop Organization and Management (3)

5320-30 Materials and Methods for Teachers of Shop and Related Subjects (3, 3)

5340 School Shop Safety (3)

5810 Development and Utilization of Advisory Committees in Education (3, 3, 3) Ramifications of vocational and technical innovations in trade and industry in relation to increasingly technically oriented society. Prereq: B.S. in Industrial Education and teaching experience.

5940 New Developments in Industrial Technical Education (3, 3, 3) Prereq: B.S. in Industrial Education and teaching experience.

School of Health, Physical Education, and Recreation

Madge M. Phillips, Director

Graduate programs are available to students preparing for (1) teaching and research positions in colleges, high schools and elementary schools; (2) administrative and supervisory work in athletics, health education, physical education, and recreation; (3) recreation 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.

THE MASTER'S PROGRAM

Four programs leading to the Master of Science degree are available: Physical Education, Recreation, Safety Education and Service, 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 3-credit-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, health planning/administration, and occupational/environmental health and safety. 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 chairperson. 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.

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.

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 doctoral 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 work for 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 concentrating 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

Safety Education and Service

School Health Education

DEGREES

Ed.D. (thesis and non-thesis options)

M.P.H.

M.S., Ed.S.

M.S.


Associate Professors: L. T. Johnson, Ed.D. Tennessee; C. B. Hamilton, Dr. P.H. Oklahoma; F. Goralch, Ph. D. (Los Angeles); M. A. Miliken (Emeritus), M.A. Yale.

Assistant Professor: A. F. Thompson, Ph.D. Michigan State.

Lecturers: M. Duffy, M.D. Pennsylvania; H. P. Hopkins, Ph.D. North Carolina.

The Health and Safety Division offers the following degree programs:

Master of Public Health degree with a major in Public Health Education. Community health education is accredited by the American Public Health Association. Options with specialization in health planning/administration or occupational/environmental health and safety are also 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 content areas relating to personal health 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 First Aid and Emergency Care. (Applicant must be at least 16 years of age for certification.) (Same as School Health 3210.)

3300 Communicable and Noncommunicable Diseases (3) Modern concepts of diseases; etiology of common communicable and chronic disease problems including prevention and control. Prereq: 1 course in biology and 1 course in bacteriology.

3320 Sanitation (3) History of sanitary awaken-; ing; disease-producing relationships and control; water, sewage, refuse, milk, meat and other foods, air, insects, and soil; sanitation of homes, swimming pools, industrial plants, mar- kets, restaurants, camps, and public buildings and places. Healthful school living as affected by buildings and grounds, lighting, acoustics, thermal control, and air and water provisions. Prereq: 1 yr biological science, 1 course in microbiology. 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 and strategies for control and prevention. Prereq: 1 course in social behavior.

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

4140 Community Health Problems—Death Education (3) Explores 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 megacities; industrial health problems of concern to management, supervisor, and industrial worker. Control of occupational diseases, poisons, accidents, and other conditions incidental to the industry.

4220 Communications for Better Health (3) Selective study of communications in health enterprise. Consideration of potential communication problems created by the mass media in disseminating new information to the public. Emphasis on the design and adoption of effective communication techniques. Prereq: 1 yr communications.

4410 Instructor's Advanced First Aid and Emergency Care (3) Designed to teach first aid. Satis- factory completion of the American National Red Cross Certification as an Advanced First Aid and Emergency Care Provider (Certifica- tion must be at least 21 years of age.) Prereqs: 3210 or valid Advanced First Aid and Emergency Care Certificate.

4420 Drug Abuse Education (3) Drug abuse problem and its history; the development of drugs and their effect on society and methods of drug abuse education.

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

4730 Workshop in Public Health Education (3-4) For teachers, nurses, case workers, sanitarians, and other voluntary and public health agency personnel; emphasizes the problem-solving approach 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 (3-15) 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/N only.
several commercially prepared tests and construction and standardization of test.

5530 School Health Program Surveys (3) Techniques and standards used in surveying total school health program; relative contribution of the health instruction, health services, and healthful environment as each contributes to well being of individual students. Survey of existing school health program.

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

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

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


6000 Doctoral Research and Dissertation

6020 Critical Analysis of Writing and Research in Health Education (3) (Same as Public Health 6020).

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

Division of Physical Education

MAJOR DEGREES

Ph.D. in Physical Education (M.S., Ed. D.

Professors: J. E. Acker, M.D. Tennessee; G. F. Brady (Emeritus), Ph.D. Iowa; E. K. Capen (Emeritus), Ph.D. Iowa; B. D. Franks (Chairperson), Ph.D. Illinois; A. J. Kozar, Ph.D. Michigan; W. P. Lief, Ph.D. Iowa; M. M. Phillips, Ph.D. Iowa; B. G. Ulrich, M.A. North Carolina; W. J. Morgan, Ph.D. Minnesota; E. T. Howley, Ph.D. Wisconsin; N. E. Lay, Ph.D. Iowa; B. D. Franks (Chairperson), Ph.D. Illinois; H. B. Watson, Ph.D. Michigan; H. G. Welch, Ph.D. Iowa; E. K. Capen (Emeritus), Ph.D. Iowa; B. A. Plotnicki (Emeritus), Ed.D. Boston; G. F. Brady (Emeritus), Ph.D. Iowa; B. D. Franks (Chairperson), Ph.D. Illinois; H. B. Watson, Ph.D. Michigan; H. G. Welch, Ph.D. Iowa; E. K. Capen (Emeritus), Ph.D. Iowa; B. A. Plotnicki (Emeritus), Ed.D. Boston;

Associate Professors: E. T. Howley, Ph.D. Wisconsin; N. E. Lay, Ph.D. Florida State; B. J. Mead, Ph.D. Purdue.

Assistant Professors: P. R. Muschaska, Ph.D. North Carolina (Greensboro); P. A. Borovicka, M.S. Tennessee; R. Crosse, M.F.A. Southern Methodist; J. L. Lewis, Ed.D. Tennessee; M. G. McCutchen, M.S. Tennessee; W. J. Morgan, Ph.D. Minnesota; B. L. Morpenaga, Ed. D. Teacher's College, Columbia; C. G. Shell, M.A. Florida State; B. G. Ulrich, M.A. North Carolina; C. A. Wrisberg, Ph.D. Michigan.

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 with concentrations in exercise physiology, anatomy and kinesiology, adaptive physical education, and general physical education.

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

3090 History of Dance and the Related Arts I (2) Dance history and the arts related to it from beginnings in primitive societies through the nineteenth century.

3151 History of Dance and the Related Arts II (2) Survey of dance and the arts related to it, tracing their development in the twentieth century.

3450 Adaptive Physical Education Laboratory (1) Practical experience in working with students with special needs, under the supervision of a physical education teacher.

4100 Advanced Dance Technique (2) Development, integration, and synthesis of previous dance vocabulary; emphasis on analysis and practice of dance principles; solo and group work. Prereq: 3020.

4200 Practicum in Dance Production (2) Prereq: Consent of instructor.

4500 Advanced Dance Composition (2) Creation and development of ideas, themes, and dance forms; solo and group work. Prereq: 3020.

4700 Stagecraft for Dance Production (2) Equipment, light design, properties, sets, and stage management.

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

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

5000 Thesis

5002 Non-Thesis Graduation Completion (3-15) 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 Administrative Problems in Health and Physical Education (3)

5120 Problems of the Curriculum in Physical Education (3)

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

5140 Advanced Philosophy of Sport (3) Critical examination of the most rigorous and sophisticated essay pieces concerning metaphysical, epistemological, and axiological status of sport. Prereq: Consent of instructor.

5150 Systematic Philosophical Analyses of Sport (3) Critical examination of most comprehensive, systematic, and revealing accounts of metaphysical, epistemological, and axiological status of sport. Prereq: 5140 or consent of instructor.

5220 Readings in Physical Education (3) 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) 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 selected specialized area within general fields of physical education. Prereq: Consent of instructor.

5500 Advanced Kinesiology (3) Action of muscles involved in fundamental movements, calisthenics, and gymnastics. Prereq: 5230 or equivalent.

5510 Selected Topics in Anatomy (3) Intensive study of various systems of human body. Prereq: 5500 or equivalent. May be repeated with consent of instructor.

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

5580 Physical Activity and Health (5) Relationship of physical exercise to longevity, weight control, cardiovascular diseases, low back pain and other disorders, mental health, growth, and aging. Applications for maintenance of health. Prereq: Course in physiology of exercise or consent of instructor. 5 lectures per week. (Same as Public Health 5580).

5600 Applied Physiology (6) Principles of physiology with special emphasis on application of physiological findings to practical problems related to human function. Prereq: 1 yr general chemistry, or consent of instructor.

5610 Advanced Exercise Physiology (4) Principles of energy transfer in man with special emphasis on integration of organ systems in adapting to requirements of muscular exercise. Prereq: Zoology 4940 or equivalent. Recommended: 1 yr chemistry, physics, and mathemetics 3 hrs and 1 lab.

5620 Experimental Techniques in Applied Physiology (5) Laboratory course in experimental methodology and instrumentation. 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) Current issues and problems in physical education with emphasis on outstanding studies and research in field.

5910-20-30 Problems and Projects in Physical Education (1, 3-3, 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 literature related to physical education. May be repeated with consent of instructor. S/NC only.

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

6410 Practicum in Kinesiology (3) Electromyography laboratory and film analysis of sports skills. Prereq: 5310, 5500 and Physics 2210 or equivalent. May be repeated with consent of instructor.

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

6610 Seminar in Applied Physiology (2) Laboratory course in experimental methodology and instrumentation. Respiratory and blood gas analysis, human calorimetry, blood chemistry, and pulmonary function tests. May be repeated with consent of instructor. S/NC only.

6650 Scientific Bases for Physical Education (3) Physiological, psychological, and sociological foundations.
Division of Recreation

MAJOR
Recreation

DEGREE
M.S.

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

Assistant Professors:

The Recreation Division offers the following degree program:
Master of Science degree in Recreation (thesis and non-thesis programs) with concentrations in general recreation, recreation administration, and therapeutic recreation.

4150 Recreation Administration (3) Introduction to recreation administration, including planning, personnel, areas and facilities, program services, finances, and public relations. Prereq: 3140, 3200, 3880, or consent of instructor.

4200 Survey of Recreation for Special Populations (3) Responsibility of recreation profession to minority groups whose leisure opportunities and needs may require special servicing. Prereq: 3140, 3200, 3880, or consent of instructor.

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. Prereq: Consent of instructor. May be repeated with consent of division. Maximum 9 hrs.

5000 Thesis

5002 Non-Thesis Graduation Completion (3-15) 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.

5130 Interpretations of Leisure (3) Concepts of leisure including social, psychological, cultural, and philosophical; recreative uses of leisure. Prereq: 3140 or consent of instructor.

5140 Leisure Service Delivery Systems (3) Various systems—public, private, and commercial—involved in provision of leisure services for community at large. Prereq: Consent of instructor.

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

5420 Therapeutic Recreation (3) Role of recreation in lives and treatment of persons with disabilities—mental, physical, and medical. Possibilities for helping ill and disabled realize their fullest potential. Prereq: Consent of instructor.

5250 Implementations of Recreation Services for the Ill or Disabled (3) Policies and guidelines for organizing and implementing programs of recreation for ill or disabled in treatment centers and other community agencies. Prereq: 4200 or consent of instructor.

5260 Leisure and Mental Health (3) Relationship between leisure activity and mental health, with emphasis on its use in therapeutic recreation. Prereq: Psychology 3650 or equivalent, and consent of instructor.

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

5340 Administration of Recreation Funds (3) Development and management of budgets for recreation agencies with special emphasis on obtaining federal funds appropriated specifically for recreation, management of revenue received, and exploration of funding alternatives. Prereq: 4130.

5350 Organizational Policies for Recreation (3) Advanced study in the analysis of organizational policies and functions of management in recreation. Prereq: 4130.

5360 Management and Operation of Recreation Facilities (3) Management process as it pertains to operation of recreation facilities.

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

5450 Specialized Study in Recreation (1-9) Advanced comprehensive study in selected specialized area within 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 videotapes prepared from a regular on-campus class in specially-equipped classrooms. The tapes contain a visual and audible record of a professor's lecture and discussions with the on-campus classes. 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 or students visit the Knoxville campus at selected times.

Graduate courses have been offered to students at other campuses and established centers of the UT System (Chattanooga, Kingsport, Martin, 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, Columbia State, and Walters State Community Colleges. 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 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 except 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 begin Japanese language study. At the option of the department, up to 6 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 as far 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:


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, and manufacturing, 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:

1. An Engineering Core, 27 hours of graduate credit consisting of Engineering Administration 5900, at least three courses chosen from 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 5051, Marketing 5130, and Transportation 5210.

3. General Electives, 9 hours of graduate credit chosen from computer science, economics, engineering, management science, mathematics, psychology, statistics, and other program-related disciplines.

The program requirement totals 51 hours of graduate 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 2110, Computer Science 3150, Industrial Engineering 4520, and Statistics 3450 or their equivalents. None of these prerequisites may be counted as part of the 51 hours of credit offered for the degree. These course prerequisites will be waived upon presentation of evidence of competency in the course subjects. Other prerequisite courses may be required, depending upon the student’s background and the electives chosen.

5002 Non-Thesis Graduation Completion (3-15)

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.

5900 Project Engineering Administration (3)

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

Departments of Instruction

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

Chemical, Metallurgical, and Polymer Engineering

MAJORS

Chemical Engineering
Metallurgical Engineering
Polymer Engineering

Professors:
H. Johnson (Head), D. Eng, Yale;
D. C. Bogue, Ph. D. Delaware; B. S. Bore, Ph. D. Massachusetts Institute of Technology;
C. R. Brooks, Ph. D. Tennessee; E. S. Clark, Ph. D. California (Berkeley); L. W. Crawford, Ph. D. Cincinnati; O. L. Cubiren, Ph. D. Texas; J. F. Fellers, Ph. D. Akron; G. C. Frazier, Ph. D. Johns Hopkins; J. M. Holmes, Ph. D. Tennessee; H. W. Hsu, Ph. D. Wisconsin; S. H. Jury (Emeritus), Ph. D. Cincinnati; C. D. Linding, Ph. D. Pennsylvania; J. McHargue, Ph. D. Texas; C. F. Moore, Ph. D. Louisiana State; B. F. Oliver, Ph. D. Illinois State; J. J. Perona, Ph. D. Northwestern; J. W. Prados, Ph. D. Tennessee; J. E. Prussiel, Ph. D. Pennsylvania; E. L. Rensselaer; Ph. D. Cincinnati; C. O. Thomas, Ph. D. Tennessee; R. A. Vandermeidere, Ph. D. Illinois Institute of Technology; J. J. Watson, Ph. D. Tennessee; J. L. White, Ph. D. Delaware; M. A. Wright, Ph. D. Wales.

Associate Professor:
W. T. Becker, Ph. D. Illinois.

Assistant Professors:
D. D. Bruns, Ph. D. Houston; P. J. Mesarz, Ph. D. Pennsylvania.

Lecturers:

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

THE MASTER’S PROGRAM

Minimum departmental requirements include the satisfactory completion of:

1. A major consisting of 18 to 27 quarter hours of graduate courses in chemical engineering, metallurgical engineering, or polymer engineering. The polymer engineering major must include Polymer Engineering 4920, 5110, 5230, 5310, and 5510.
2. One or two minors or collateral work, 9 to 18 hours total in engineering, chemistry, mathematics, physics, or other related fields.
4. Active participation in graduate seminars in the department. Resident students must register for the appropriate 5010 every quarter offered.
5. Final examination covering thesis, related fields, and graduate course work.

THE DOCTORAL PROGRAM

Students applying for entrance into the doctoral program must display concrete evidence of ability and experience that approach 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. The polymer engineering major must include Polymer Engineering 4920, 5110, 5230, 5310, 5510, and Chemistry 5140.
2. Supporting courses in related scientific and engineering fields amounting to a total of 36 quarter hours, subject to approval by the student's faculty committee. These related fields will normally include chemistry, mathematics, physics, and 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 seminars conducted by the department. Resident students must register for the appropriate 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, and 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 an engineering emphasis, and a second in a joint program with the Chemistry Department having a chemical emphasis.

The specialization program in this department requires, for the M.S. degree, a thesis in the field, completion of Polymer Engineering 4910, 4920, 5110, and either 5230 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
Polymer Engineering 4910 and 4920, Chemistry 5531 and 5140, plus active participation in the Polymer Seminar. Ph. D. candidates will complete a written dissertation based upon completed research and pass a special written examination as well as complete the above requirements.

Chemical Engineering

3410 Flow of Fluids (4) Differential and integral analysis of fluid mechanics including; flow in tubes, piping systems, and packed beds; metering devices, pumps. Prereq: Chemical and Metallurgical Engineering 2200, Mathematics 2850. 3 hrs and 1 lab.

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

3440 Stagewise Operations (3) Analytical and graphical methods applied to stagewise separation operations. Prereq: Chemical and Metallurgical Engineering 3040.

3450 Diffusional Operations (3) Diffusion, simultaneous first order chemical reaction, heat transfer, applications including humidification, gas absorption, extraction. Prereq: 3420, Chemical Engineering 3040.

3610 Introduction to Process Dynamics and Control (3) Steady state analysis of a system, Laplace transforms, block diagram algebra and transfer functions. Mathematical models for several processes are developed and analyzed in detail. Prereq: Mathematics 2840.

3620 Chemical Process Control (3) Basic control theory applied to chemical processes: feedback control, cascade control, feed-forward 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 processes; statistical process control. Prereq: 3420 and Mathematics 3150.


4130 Introduction to Optimization (3) Principles and applications of optimization techniques to chemical process design; unconstrained optimization, equality constrained optimization, inequality constrained optimization; dynamic programming. Prereq: Mathematics 2840.


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, and operating costs and economic merit. Prereq: 4410, 4530.

4210 Special Problems in Design and Economics (3) Extension of 4420 for student participation in the American Institute of Chemical Engineering annual contest problem; other advanced design projects. Prereq: 4420.

4430 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.

4470 Sulfur Removal from Coal and Associated Problems (3) Chemical and physical properties of domestic coals; beneficiation by both physical and chemical methods; fluidized bed combustion with both natural and synthetic SOx scrubbing. Prereq: Consent of instructor.

4480 Coal Processing to Liquid Fuels (3) Characterization of various coals with respect to current liquefaction methods; modeling of conversion processes and estimation of maximum yields; water and oxygen requirements; pyrolysis; catalytic hydrogenation; reactor design considerations. Review and critique of selected articles from both the current literature and patents. Prereq: Consent of instructor.

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


4620 Process Modeling, Simulation, and Control of Chemical Engineering Processes (3) First order plant models, experimental process identification, process computer simulation, conventional and nonconventional control, 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 biomass and energy transfer. Thermodynamics of transport and equilibrium in biological systems. Discussion of Volterra's equation and biological clocks. Prereq: Consent of instructor.

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

4750 Microbiological Process Engineering (3) Application of chemical engineering principles and design concepts to microbiological processes; continuous culture of microorganisms, food processing and biological 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 Chemical Bioengineering (3, 3) Principles of interest in chemical bioengineering. Prereq: Consent of instructor.

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

5050 Engineering Analysis (3) Analytical formulation and solution of chemical, metallurgical and polymer engineering problems involving deformation of solids, heat transfer and motion of fluids, transfer processes, and optimization. 5050 and Polymer Engineering 5050.

5120 Heat Convection (3) Analysis of heat convection in fluids under viscous and turbulent conditions. Laminar boundary layer flow, low Reynolds number flow, combined conduction and convection; simultaneous diffusion of momentum and heat. Prereq: 5050.

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

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


5310 Thermodynamics of Heterogeneous Equilibrium (3) Phase rule; equilibrium between phases; composition relationship between phases; ideal and nonideal solutions. Prereq: 3040.

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

5410-30-50 Research and Design in Chemical Engineering (3, 3, 3) Selected diffusional operations; interpretation of laboratory data and design of experiments in chemical engineering research.

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

5610 Stagewise Mass Transfer Operations (3) Equilibrium stage models applied to mass transfer operations, emphasizing nonisothermal and multicomponent systems.

5620 Differential Mass Transfer Operations (3) Differential mass transfer operations; falling film, packed tower, and instability of mass transfer devices; nonisothermal and multicomponent systems; current theories of mass transfer; mass and momentum transfer analogies. Prereq: Mathematics 2840.

5810 Mechanics of Viscous Flow (3) (Same as Engineering Science and Mechanics 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) Fixed and fluidized bed operations, stagewise and differential mass transfer bed concepts. Prereq: Consent of instructor.

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

6310 Thermodynamics of Irreversible Processes (3) Thermodynamic treatment of irreversible chemical processes, transport processes, coupling phenomena, with special emphasis on the heavy chemical industrial application to petroleum engineering and bioengineering students. Prereq: 5310.


6410 Stability Phenomena in Chemical Engineering (3) Analysis of qualitative and quantitative stability and instabilities in fluids based upon differential equations. Prereq: 6410.

6420 Stability Phenomena in Chemical Engineering: Continuous Systems (3) Hydrodynamic instabilities and instabilities in fluids based upon

6510 Applied Chemical Reaction Kinetics (3) Chemical reaction in gas and liquid phases, heterogeneous catalysis, catalyst effectiveness and reaction rate modeling in kinetics. Emphasis on development of phenomenological description although mechanistic models are discussed. Prereq: 5510.

6520 Catalytic Reactor Design (3) Principles of kinetic heat and mass transfer applied to design and analysis of heterogeneous catalytic reactors. Prereq: 6510.

6610 Special Topics in Chemical Engineering (3) Advanced problems of current interest to chemical engineers. Prereq: Consent of instructor.

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

Metallurgical Engineering

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.

3120 Engineering Materials II (3) Extension of 2110 or 3110 with emphasis on control of mechanical properties of metals by specification of chemical composition, mechanical treatment; correlation of resultant properties with service performance. Suggested for mechanical, civil, and industrial engineering students.

3130 Engineering Materials III (3) Extension of 2110 or 3110 with emphasis on control of electrical and magnetic properties of materials by specification of composition, thermal, and mechanical treatment; correlation of resultant properties with service performance. Suggested for electrical engineering students.

3140 Engineering Materials IV (3) Extension of 2100 or 3110 with emphasis on materials processing, specification and evaluation. Suggested for mechanical and industrial engineering students.

3150 Engineering Materials V (3) Extension of 3110 with emphasis on the mechanisms and control of reactions of engineering materials with applications to nonaqueous and gaseous environment. Prereq: 3110 or equivalent.

3160 Engineering Materials VI (3) Extension of 2110 or 3110 with emphasis on materials of significant materials processing importance: construction materials, nuclear fuel materials, and interaction of radiation with solids to produce changes in engineering properties. Suggested for nuclear and mechanical engineers.


3220 Diffusion and Annealing (3) Introduction to solid state kinetics and point defects, solid solutions, diffusion equations and mechanisms, annealing of cold worked structures. Prereq: 3210; Mathematics 2840.

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

3310 Biomedical Applications of Materials for Life Sciences (3) Principles of engineering materials; metals, polymers, and ceramics; methods of fabrication of components; correlation of prosthetic devices and dental materials. Prereq: Chemistry 1110-20-30 or equivalent.

3520 Materials Behavior and Chemical Process Equipment Design (3) Kinetic, metallurgical and chemical considerations in design of chemical processing equipment. Prereq: Chemical and Metallurgical Engineering 3000 or equivalent; 3150; and Chemical Engineering 3420. (Same as Engineering Science and Mechanics 3520.)

3710 Metallurgical Applications in Manufacturing Technology (3) Principles of mechanical/thermal processing for mixing, and phase transformations in ferrous alloys. Plain carbon steels, alloy steels, and tool steel processing for property selection and service requirements. Prereq: 2320 or consent of instructor.

4240 Engineering Materials Design (3) Property control through composition, heat treatment and transformation in ferrous alloys. Plain carbon steels, alloy steels, and tool steel processing for property selection and service requirements. Prereq: 5510 or consent of instructor.

4250 Design and Analysis (3) Design and laboratory experiments on more recent advances in metals technology and applications. Prereq: Senior standing.

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

4610 Physical Properties of Materials (3) Electron theory of solids, types of bonding in solids; thermal, electrical, and magnetic properties of materials; relationship between metallurgical structure and properties. 3 hrs, or 2 hrs and 1 lab.

4720 Production Metallurgy (3) Thermodynamic and kinetic principles of roasting, smelting, refining. Prereq: Chemical and Metallurgical Engineering 3040.

4730 Mechanical Metallurgy I (3) Elastic behavior, description of stress, strain and elastic constitutive relations. Effects of composition, microstructure, and loading on mechanical behavior. Failure by yielding. Prereq: 2110 or 3110 and Chemical and Metallurgical Engineering 2030. Suggested for students specializing in engineering, engineering mechanics and engineering science students. 3 hrs, or 2 hrs and 1 lab.


4750 Phase Transformations I (3) Analysis of decomposition. Prereq: 5140.

4760 Casting and Welding (3) Principles and processes of casting and welding; heat transfer, solidification, segregation, gas-metal and slag-metal interactions, thermal treatments, associated stresses. Prereq: 3120 or 3230. 3 hrs, or 2 hrs and 1 lab.

4770 Mechanical Metallurgy III (3) Finite plastic strain. Plastic stress-strain relations. Principles of fabrication: forging, swaging, extrusion, rolling, deep-drawing. Prereq: 5610 and consent of instructor. Suggested for mechanical engineering, engineering mechanics, and mechanical engineering students majoring in 3 or more, or 2 hrs and 1 lab.

5000 Thesis

5010 Graduate Seminar (1) May be repeated. Prereq: Admission. Prereq: 5050 or consent of instructor.

5050 Engineering Analysis (3) (Same as Chemical Engineering 5050.)
5910-20-30 Metallurgical Thermodynamics (3, 3, 3) Phases of solid state physics applicable to metal- lurgy. Stability, introductory quantum theory of specific heats, electron theory, electrical and thermal conductivity, magnetic properties, theory of superconductivity. Prereq: 4610 or Math 3720; Mathematics 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 transformation.

6320-30 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 liquids to solid transition, multiphase solidification, composites, nonequilibrium thermal and fluid phenomena, some nucleation phenomena. Prereq: 5310.

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

6810 Mechanical and Physical Properties of Crystals I (3) Anisotropic behavior of crystalline materials treated by matrix and tensor techniques. Property classification according to transformation behavior. Prereq: Core curriculum in Mechanical Engineering and Mathematics 5050 or 4710 or consent of instructor.

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

Polymer Engineering
4910 Applied Polymer Science (3) 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.

4920 Polymer Processing (3) Rheological properties of polymer melts and solutions, viscometry, unit operations of fiber, plastics and rubber industries: dimensional analysis and scale-up, flow through dies and pipelines, screw extrusion, spinning of fibers, injection molding.

4930 Principles of Fiber and Textile Engineering (3) Chemical and crystalline structure of important fibers; melt and wet dry spinning of man-made fibers; drawing and texturizing; preparation of yarn; dyeing, weaving and knitting. Emphasis on qualitative aspects.

4940 Plastics Fabrication Operations (3) Lecture and laboratory course treating unit operations of the plastics industry. Types and mechanisms of operations of manufacturing processes and the structure and properties of fabricated parts. Operations to include extrusion, coextrusion, injection molding including transfer molding and blow molding, rotational molding.

5000 Thesis

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

5050 Engineering Analysis (3) (Same as Chemical Engineering 5050.)

5110 Structural Characterization of Polymers (3) Experimental methods of determining nature of transitions and structural characteristics of polymers most pertinent to plastics, fibers, and rubber applications. Methods of determination of tacticity, crystalline structure, orientation, morphology including x-ray diffraction, nuclear magnetic resonance, and electron microscopy. Coreq: 4910 or equivalent.


5310 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 Scientists (3) Laboratory course in modern methods of characterization of polymers; gel permeation chromatography, intrinsic viscosity, spectrophotometry, 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, spinodal decomposition, application to crystallization from the melt, precipitation from solution.

5810 Physical Properties of Polymer Structures (3) Molecular weight and composition distributions in copolymers plus structures of two phase block polymers and polymer mixtures as related to glass transition and crystalline phases, compatibility, thermal-mechanical, and optical properties.

5910-20-30 Selected Topics in Polymer Science (3, 3, 3) Modern polymeric materials, recent developments. Phases of current interest to engineers. Prereq: 4910, 4920 or equivalent.

6000 Doctoral Research and Dissertation

6110 Optical Properties of Polymers (3) Maxwell's equations and electromagnetic theory of light, optical properties of isotropic and anisotropic dielectrics including theory of birefringence, applications to spherical 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 film diffraction; Laue, Karman, and Fourier methods; helical nets and Bessel function techniques; levels of order, thermal motions, defects, order-disorder transitions and paracrystallinity. Precision and Weissenberg photography, single crystal and powder diffraction intensities and relationships to synthetic and biological macromolecules.


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

6230 Advanced Mechanical Behavior of Polymer Materials: Stress analysis with emphasis on developing constitutive equations for yielding behavior of solid polymers, failure analysis and geometric and material nonlinearity in solid polymers. Relation of microscopic properties to molecular structure.

6810 Advanced Industrial Polymer Chemistry (3) Chemistry and properties of new polymer engineering materials; highly integrated engineering and chemical approach. Prereq: Consent of instructor.

6910-30 Recent Advances in Polymer Science and Engineering (3, 3, 3) Treatment of latest developments in science and technology of polymers. May include topics of morphology, structure, characterization. Prereq: Consent of instructor.
THE DOCTORAL PROGRAM

A graduate program leading to the degree of Doctor of Philosophy is offered in Civil Engineering. 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 Doctoral Research and Dissertation. If 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 9 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 may include such disciplines 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: 4110 and 4410.

4220 Foundations and Substructures (3) Foundation exploration; principles of design of dry and subaqueous foundations. Prereq: 3310.

4230 Legal and Ethical Aspects of Engineering (3) Legal principles underlying engineering work; laws of contracts, torts, agency, real property, professional engineering practice and the ethics of engineering. Prereq: 4110 and 4410.

4240 Structural Design (3) Plastic theory, eccentric connections, industrial building design, timber design. Prereq: 3320 and 4410. 2 3-hr periods.

4280 Photogrammetry (3) Methods of plotting maps from aerial photographs; stereoscopic plotting instruments; applications. Prereq: 2580 or Forestry Summer Camp for forestry majors.

4420 Analysis of Framed Structures (3) Maximum stresses due to moving loads, including influence lines; lateral forces due to earthquake and wind; analysis of portals, building frames and space frames. Prereq: 4110 and 4410. 2 3-hr periods.

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

4510-20 Advanced Structural Design (3) Plastic design in steel in 4510; design of typical steel span highway bridges in 4520. Prereq: 3220 for 4510; and 3230 and 4110 for 4520.

4530 Cost Comparison in Design and Construction (3) Cost of engineering and construction. Cost comparison of alternate designs with emphasis on applications to civil engineering problems. Prereq or coreq: 3230, 4110.

4540 Computer Utilization (3) Computer use, environmental justification, and use of computers in the civil engineering industry. Utilization of computers for solution of civil engineering problems. Prereq or coreq: 3230.

4550 Engineering Behavior of Soils (3) Plastic and elastic behavior of soils, determination and use of engineering properties of in-situ soils. Prereq: 4220 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 of the disposal of soil wastes with additives. Prereq: 3310. 2 hrs and 1 lab.

4620 Airport Planning and Design I (3) Emphasis on airport master planning. Included for consideration on the air side are runway configuration and capacity, geometry and lighting; on the land side are terminal layout and design, and ground access systems and parking. Prereq: 3600 and 3610.

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

4700 Portland Cement Concrete Mix Design (3) Properties and tests of portland cement concrete, methods of concrete mix design, non-densifying concrete, structural concrete admixtures. Prereq: 3710. 2 hrs and 1 lab.

4720 Asphalt and Bituminous Concrete (3) Properties and tests of asphalts and asphaltic mixes, mix design of bituminous concrete. Emphasis on use of asphalt in transportation construction projects. Prereq: 3710. 2 hrs and 1 lab.

4731-32 Earthquake Resistant Structures I, II (4, 4) (Same as Architecture 4731-32.)

4800 Introduction to Civil Engineering Systems (3) Methods of modeling civil engineering systems and their specific application to problems of transportation, environment, water resources and materials. Prereq: Senior standing or consent of instructor.

4850 Elementary Structural Matrix Methods (4) (Same as Engineering Science and Mechanics 4800 and Architecture 4800.)

5000 Thesis

5002 Non-Thesis Graduation Completion (3-15) 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. 5/NC only.

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

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

5150 Matrix Formulation of Structural Problems (3) Review of matrix algebra, vectors, stability considerations; stiffness, flexibility and strength 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) Bending and buckling of plates; 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; elastoplastic behavior considered. Prereq: 5120, 5150.

5180 Finite Element Structural Analysis (3) Application of finite element method to structural analysis of plane stress, plane strain, axisymmetric, and three-dimensional elements; use of typical computer programs. Prereq: 5150, and Engineering Science and Mechanics 5180. (Same as Engineering Science and Mechanics 5180.)

5220 Pavement Design (3) Pavement loads; pavement design; design practices; construction and maintenance. Prereq: 3319.

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.

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

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

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

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

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

5430-40-50 Construction Management I, II, III (3, 3, 3) Management and organization of heavy and building construction projects. Prereq: 4430 or consent of instructor.

5460-70 Construction Estimating I, II (3, 3) Project costs, estimating techniques; market cost conditions and feasibility of design as it applies to costs. Prereq: 4430 or consent of instructor.

5550 Soil Mechanics—Plastic Equilibrium (3) Failure theories; earth pressure analysis, bearing capacity; stability analysis. Prereq: 3310 or consent of instructor.

5660 Soil Mechanics—Elastic Behavior (3) Stress-deformation characteristics, consolidation, settlement analysis. Prereq: 3310 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: 3310 or consent of instructor.

5610 Behavior of Structural Steels (3) Behavior of structural steel members due to static and fatigue loading; relation between research results and current specifications for design. Prereq: 4720.

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

5740 Behavior of Reinforced Concrete Members (3) Behavior of reinforced concrete members; relation between research results and current specifications for design. Prereq: 4720.

5800 Urban Systems: Engineering and Management (3) Management of various urban systems usually under city manager and/or city engineer.

Organization, finance, personnel administration, purchasing and equipment management, and dealing with engineering consultants as each deals with municipal public works. Prereq: Graduates standing in Civil or Environmental Engineering or consent of instructor.

5850 Urban Systems: Engineering and Management (II) (3) Continuation of 5800. Management and planning of urban streets, including lighting, cleaning and snow removal, water supply and waste-water drainage, solid waste, air pollution and land use regulations. Prereq: 5850.

5860 Traffic Engineering—Characteristics (3) Driver-vehicle-roadway system; level-of-service concept of capacity. Coreq: Statistics 3450 or 5511, 2 hrs and 1.2-hr lab.

5870 Traffic Engineering—Operations (3) Fixed-time and volume-density controllers; progressive systems; one-way operations; reversible flows; system operation, including computerized networks; legal aspects of operational controls. Prereq: 5860, 2 hrs and 1.2-hr lab.

5840 Geometric Design (3) Advanced theory and practice in the geometric design of highways. Prereq: 4600.

5850 Functional Design of City Streets and Urban Freeways (3) Special systems and planning aspects of urban growth and development; classification and function of streets; design features, including street size, street intersections, types, utility systems, pricing, parking, effect of mass transportation; channelization; marketing; lighting; freeway, frontage road and street system. Prereq: Consent of instructor.

5860 Urban Transportation Planning (3) Prediction of traffic demands and vehicular flows; land use planning; parking needs. Prereq: 5810.

5880 Public Transit Planning (3) Intuitively constructed and objective specifications of public transportation. Prereq: 4430 or 4710.

5890 Traffic Accident Reconstruction (3) Proper traffic accident data collection and analysis as basis of designing accident prevention or control programs. Many contributing factors to an accident; proximate and secondary accident causes as they relate to roadway improvements. Prereq: 4640 or 5810 or consent of instructor.

5900 Special Problems in Civil Engineering (1-4) To fulfill special problem requirement in the non-thesis program. Enrollment limited to civil engineering students in non-thesis program. Prereq: Consent of instructor. May be repeated. Maximum 9 hrs. S/J/N only.

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

6000 Doctoral Research and Dissertation

6160 Behavior of Steel Bridges and Buildings (3) Behavior, analysis, and design of plate girders, columns and composite members subjected to static and dynamic loading. Prereq: 5710 and 5761.

6740 Behavior of Reinforced Concrete Beams and Frames (3) Ultimate strength and behavior of statically indeterminate reinforced concrete structures; analysis or design of reinforced concrete framed structures; limit analysis. Prereq: 5120 and 5740.

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 Engineer Science and Mechanics 5130.

6830 Traffic Flow Theory (3) Queueing theory; Markov processes, Monte Carlo methods, simulations of various conditions and/or designs. Prereq: 5450 or Mathematics 3150, 5620.

6860 Statewide Passenger Transportation Planning (3) Continuation of 5860. Management and planning of urban transportation system, including traffic models, functional assessment, and scheduling. Emphasis on government policy decisions, how they affect air and highway investments. Prereq: 5860.

6870 Future Transit Technology and Research (3) New transit systems and new technology; identification of possible future urban transportation planning and planning processes. Prereq: 5870.


6910-20-30 Special Topics in Civil Engineering (3, 3, 3) Special topics in new developments in civil engineering. Prereq: Consent of instructor.

6920 Water Resources Engineering Design (3) Elements of water resource structures and systems, including reservoirs, dams, control works, and open channel design. Dam safety control, environmental impact and water resources engineering. Prereq: 3310 or consent of instructor.

Environmental Engineering

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


4150 Urban Water Management (3) Introduction to urban water modeling; evaluation of optimum urban water policies; formulation of system constraints and analyses of decision-making process; management of storm water for beneficial use. Prereq: 3000 and 3330.

4210 Water Resources Engineering Design (3) Elements of water resource structures and systems, including reservoirs, dams, control works, and open channel design. Dam safety control, environmental impact and water resources engineering. Prereq: 3330 or consent of instructor.

4220 Water Resources Engineering Development (3) Multiobjective evaluation procedures for comparing and selecting among water resources development alternatives; achieving project optimality; single- and multi-purpose projects; special topics in new development in water resources engineering. Prereq: 3330 or consent of instructor.

4330 Hydrologic Design (3) Application of frequency and regression methods to hydrologic design of water resources system; unsteady surface runoff and streamflow modeling; urban peak flow hydrograph simulation; wave theory; evaluation of effects of land use changes on streamflow quantity and quality. Prereq: 3330.

4510 Elements of Water and Wastewater Transportation Systems (3) Introduction to theory and design of water transportation and distribution systems and wastewater collection systems. Prereq: 3000, 3120 and 3330.

5420 Elements of Water and Wastewater Treatment Systems Design (3) Introduction to design of water operations and processes employed in physical, chemical, and biological treatment of water and wastewater. Application assignment to unit operations and
processes in design of water and wastewater treatment plants. Prereq: 5000 and 5120.

4530 Sanitary Engineering Laboratory (3) Physi- cal, chemical, and biological characteristics of water and wastewater. Prereq: 4530. 3 labs.

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

4700 Air Pollution-Air Resource Management (3) Introductory course on concepts of air pollution; analysis of chemical and developmental models used in 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 and water law doctrines. (Same at Water Resources Development 4810.)

4820 Environmental Engineering Law (3) Legal aspects of water and air pollution, drainage, land use controls, and environmental impact statements with emphasis upon federal-state relations, recent legislation and court decisions, and enforcement. Prereq: Senior standing.

5000 Thesis

5002 Non-Thesis Graduation Completion (3-15) Required for the non-thesis student not otherwise registered during any quarter when such a student has completed all requirements and the time before degree is completed. May not be used toward degree requirements. May be repeated. S/N only.

5150 Water and Urban Welfare (3) Social, environ- mental, and economic impact on planning and management of urban water systems. Emphasis upon conflict and choice, reconciliation between economic and environmental values, measurement of social well-being and quality of life parameters. Analyzing multiobjective policy alternatives with selected case studies. Prereq: Consent of instructor.

5160 Planning and Utilities (3) Planning for ade- quate water supply and sewage waste disposal in the urban environment. Impact of utility patterns on area development, and problems of utility serv- ice policies. Not for civil engineering majors. (Same as Planning 5160 and Water Resources De- velopment 5160.)


5232 Sediment Transportation (3) Sediment prop- erties and measurements; bed loads and sus- pended load movement; erosion, scour, transporta- tion and deposition of sediments by flowing water; settling of reservoirs and related topics. Prereq: 5230.

5234 Flood Damage Reduction (3) National, re- gional, local flood problems; hydrologic design criteria; traditional flood control measures; land use controls and adjustments; floodproofing, flood insurance, and other flood damage reduc- tion elements; interdisciplinary approach in floodplain management; case studies. Prereq: Consent of instructor.

5261 Basic Principles of Remote Sensing (3) Ap- plications of remote sensing in agriculture, engi- neering, forestry, and natural resource planning, and resource management; properties of electromagnetic radiation including wave theory, physical optics, geometric optics, and the interac- tion of EM radiation and matter; current data handling technology. Prereq: Consent of in- structor.

5262 Remote Sensing Data Acquisition (3) Active and passive remote sensing as methods of applica- tion and limitation; description of remote sensing platforms, including the Earth Re- sources Satellite Communications System; mis- sion planning. Prereq: 5261 or consent of in- structor.


5301 Stormwater Modeling I (3) Interpretation of hydrologic data using methods of systems analy- sis. Hydrologic components are analyzed as linear and nonlinear systems, transformed into math- ematical models of watershed response. Optimiz- ing model parameters with illustrative examples. Prereq: Consent of instructor.

5302 Stormwater Modeling II (3) Continuous and discrete records presented using methods of stochastic hydrology, including flow fre- quency and time series analysis. Hydrologic design of water systems using streamflow simulation techniques including autoregressive and fractional gaussian noise models. Prereq: Consent of instructor.

5210 Groundwater Transport Processes (3) Dy- namics of flow in porous media with emphasis on physical processes important in subsurface hydrology, including anisotropy, layered soils, and unsaturated flow phenomena. Analytical solutions of flow equations, Dupuit approximation, numerical methods, Hele-Shaw, and graphical solutions. Prereq: En- gineering Science and Mechanics 5110 or consent of instructor.

5330 Descriptive Hydrology (3) Occurrence and description of elements of hydrologic cycle, ef- fects on earth and relation to man. Not for civil engineering majors. (Same as Water Resources Development 5330.)

5400 Introduction to Environmental Systems (3) Models of air and water quality, water resources, solid waste disposal, and location of central fa- cilities; exposure to current literature on environ- mental management problems; optimization of these systems. Prereq: Consent of instructor.

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

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


5530 Environmental Engineering and Natural System Behavior (3) Relationship between envi- ronmental engineering and natural system be- havior, focusing on eutrophication and limiting nutrient concept in relation to research and translation into law and wastewater engineering practice. Seminar-open discussion format. Prereq: Graduate standing or consent of instructor.

5551 Water Quality Management (3) Water qual- ity control objectives, methods, and philosophies; water quality criteria; effect of various uses on water quality; management of water quality and waste assimilation capacity; regulatory standards; economic considerations. Prereq: 3000 or consent of instructor.

5561 Environmental Management of Water Qual- ity (3) Water quality management and concepts of quality as a dimension of water; effects of agricultural, domestic, and industrial use upon water quality; legal and administrative aspects of waste assimilative capacity and wasteload allo- cation; use of engineered water reclamation and management of water quality via nonstructural as well as biological, physical/chemical and advanced treatment proc- esses. Prereq: 3000 or equivalent.

5582 Microbiology for Sanitary Engineers (3) Microorganisms and microbial processes significant in sanitary engineering, including basic microbiology, detection and identification, enzyme metabolism, chemical and biological analysis, and wastewater treatment processes. Prereq: Graduate standing.

5593 Advanced Sanitary Engineering Laboratory (3) Laboratory course for design and performance of wastewater. Application of modern instrumental procedures for physical, chemical, and biological analysis. Prereq: 4530. 3 labs.

5600 Solid Wastes (3) Magnitude and character- istics of solid waste problem; methods for col- lection and disposal of solid wastes, including sanitary landfill, incineration, composting and previously proposed new technologies, and recycling. Prereq: Graduate engineering major or consent of instructor.

5610 Solid Waste Disposal (3) Problems in the areas of landfill design and costing, incinerator design and costing, and special topical areas. Prereq: 5600.


5700 Air Pollution and Air Pollution Control (3) Rela- tionship between air pollution, area develop- ment, and urban growth. Social, economic, and political processes involved in air pollution con- trol.

5710 Air Pollution Control Engineering (3) Emis- sion control systems for industrial and power generating processes, stack sampling methods, air monitoring, dispersion of pollutants. Prereq: 4700 and Engineering Science and Mechanics 3110.

5720 Air Pollution Particle Collection Theory (3) Analysis of particulate mass, size, and compositions in an urban medium including particle motion, coagulation, and aerodynamic capture of particles. Prereq: 4700 and Engineering Science and Mechanics 3110.

5725 Air Quality Modeling and Impact Assess- ment (3) Techniques to assess the air quality impact of major transportation projects and indus- trial air pollution sources. Application of atmospheric dispersion models and evaluation of meteorological and air quality data. Prereq: Grad- uate standing. Consent of instructor.

5730 Air Pollution Control Device Design (3) Design and evaluation of systems used to control emission of gaseous and particle air pol- lutions comprehensively from specific de- vices and systems. Prereq: 5720.

5735 Industrial Source Sampling (3) Sampling methods for gaseous and particulate air pol- lution emissions from industrial processes. Prereq: Graduate standing. 2 hrs and 1 lab.

5740 Dynamical and Physical Meteorology (3) Physical principles of the atmospheric sciences. Atmospheric energetics, general circulation, per- turbation theory, vorticity theory, the equation of motion, solar and terrestrial radiation, thermo- dynamics of dry and moist air. Prereq: Math- ematics 4550 and Engineering Science and Me- chanics 3110 or equivalent.

5750 Turbulence in the Atmosphere (3) Theoretical boundary layer mean wind and tem- perature profiles derived and related to observa- tions. Estimating surface fluxes, energy spectra, and cospectra. How theories can be applied to turbulent structures in turbulence in air flow over urban areas. Mechanisms of formation of clear air turbulence in shear zones in free atmosphere.

5760 Diffusion in the Atmosphere (3) Movement and dilution of natural or man-made material released into the atmosphere. Basic theory. Rise of buoyant plumes, relation between Eulerian and Lagrangian spectra, differences between
the areas of circuit theory, computers, electronics, communications theory, electro-magnetic theory, plasma engineering, power systems, solid-state electronics, and control systems.

Specific departmental requirements for the Ph.D. program include:
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 dissertation.
4. Satisfactory performance on both a written and an oral preliminary examination.
5. Participation in department seminars.

The 72 quarter hours of course work must satisfy the following requirements:
- A minimum of 36 quarter hours of work in electrical engineering at the 5000 and 6000 level.
- A minimum of 12 quarter hours of 6000-level course work. At least 3 quarter hours of this work must be in an area other than the student's major area.

Electrical Engineering

MAJOR

DEGREES

Electrical Engineering

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

Professors:

J. M. Googe (Head), Ph.D. Georgia Institute of Technology; P. E.; J. M. Bailey, Ph.D. Georgia Institute of Technology; A. O. Bishop, Ph.D. Clemson; T. V. Blaok, Ph.D. Tennessee; R. E. Bodenheimer, Ph.D. Northwestern; R. C. Gonzalez, Ph.D. Florida; W. L. Green, Ph.D. Boston University; R. C. Habberstien, Ph.D. Harvard; E. H. Hirschman, Ph.D. Texas; J. C. Hung, Ph.D. New York; E. J. Kennedy, Ph.D. Tennessee; P. E.; W. O. Leffell (Emeritus), M.S. Tennessee; M. O. Pace, Ph.D. Georgia Institute of Technology; P. Z. Peebles, Ph.D. Pennsylvania; J. F. Pierce, Ph.D. Pittsburgh, P. E.; W. R. Rochelle, Ph.D. Maryland; F. M. Shafner, Ph.D. Tennessee; P. E.; B. Smith, M.S. Illinois; P. E.; J. D. Tilman, Ph.D. Auburn; C. H. Weaver, Ph.D. Wisconsin, P. E.

Associate Professors:


Assistant Professors:

J. D. Birdwell, Ph.D. Georgia Institute of Technology; D. W. Boudin, Ph.D. Vanderbilt; J. W. Wailer, Ph.D. Tennessee.

THE MASTER'S PROGRAM

Graduate work leading to the Master of Science degree in Electrical Engineering may be completed during one academic year of full-time study, or the degree may be obtained in two or three years of study in the evening. Graduate 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. Electrical Engineering 5710 is normally available in both fall and spring quarters. Students electing courses such as 5850-80, 5720-30, or 5870-60 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 Math 4710, 4550, or 4250-20-30. Other approved 4000-5000 level mathematics courses must be substituted for any of the above course material covered in graduate work.
3. An additional 18 quarter hours of 5000-level work in electrical engineering or 9 quarter hours of 5000-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.

MASTER OF ENGINEERING PROGRAM

A graduate program leading to the Master of Engineering degree is available to qualified students who do not seek a Ph.D.-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, or 4250-20-30. Other approved 4000-5000 level mathematics courses must be substituted for any of the above course material covered in graduate work.
3. An additional 18 quarter hours of 5000-level work in electrical engineering or 9 quarter hours of 5000-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.

THE DOCTORAL PROGRAM

The Ph.D. degree with a major in Electrical Engineering may be pursued in
state analysis of induction motors and d.c. machines. Prereq: 3040. Includes biweekly lab.

3000 Energy System Operation (3) Synchronous machines, transmission-lines, and transformers as power system elements; power system repre-
sentations, stability, large power systems, and power system components, and fault studies. Prereq: 3080. Includes biweekly lab.

3100 Random Signals and Noise in Engineering (3) Theory of random signals and spectral analy-

3110 Basic Electrical Engineering—Circuits and Fields (3) For non-electrical engineering majors. Prereq: Mathematics 2850, Physics 2310-30. 3 hrs including biweekly lab.

3120 Basic Electrical Engineering—Electronics (3) For non-electrical engineering majors. Prereq: 3110. 3 hrs including biweekly lab.

3130 Basic Electrical Engineering—Machine (3) For non-electrical engineering majors. Prereq: 3110. 3 hrs including biweekly lab.

3180 Logic Design of Digital Systems (3) Introduction to boolean algebras and design of combinational circuits. Presents gate and flip-flop characteristics. Design of clocked sequential circuits and other systems containing memory. Introduction to microcomputer architecture and systems. Topics include basic design of digital systems, a design example such as active filters, and control systems. Instruction set capabilities and microprogramming of control function. Prereq: 3010, Computer Science 3150. 3 hrs including biweekly lab.

3190 Plasma I (3) Engineering applications of plasma, including plasma effects and de-
vices. Topics include electrostatic precipitators and plasma light sources, laser operation and applications (electro-optics), and MHD control. Thermonuclear and other techniques of advanced plasma production. Prereq: Physics 2310-20-30. 3hrs including biweekly lab.

3720 Linear Systems Analysis (3) Steady-state and transient response; log-frequency, gain-
phase, and polar plots; block diagram transfor-
mation; signal flow graphs; analogous systems, properties of second order systems; introduction to feedback theory; stability criteria. Prereq: 3050, 3150. 3 hrs including occasional labs.

3810 Electronics I—Basic Electronic Processes (3) Current conduction in semiconductors and high vacuum; theory of p-n junctions, character-
istics of diodes; rectifiers and diode switches. Prereq: 3040 concurrently. 3 hrs including biweekly lab.

3820 Electronics II—Basic Electronic Devices (3) Characteristics and equivalent circuits of vac-
uum tubes and transistors with application to amplifier and control circuits. Prereq: 3810. 3 hrs including biweekly lab.

3830 Electronics III—Basic Electronic Amplifiers (3) Vacuum tube and transistor RC coupled amplifiers; tuned amplifiers; basic power amplifiers; bias networks, feedback. Prereq: 3010 and 3820. Coreq: 3720. 3 hrs including biweekly lab.

4020 Direct Electrical Energy Conversion (3) Basic principles, typical devices and applica-
tions for production of electrical energy by thermoelectric effects, thermionic conversion, magnetohydrodynamics, solar cells, and fuel cells and current demonstrations. Prereq: 3060, 3190 and 3810.

4080 Microwave Circuits and Electronics (3) Circuits represented by wave shattering, isolators, and filters. Magnetic and electric field devices, parametric amplifiers, power generator semiconductors, varactor semiconductors. Prereq: 3060, 3190 and 3810.

4090 Propagation II (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: 3060, 4 labs.

4100 Digital Communication Systems (3) Principles of pulse and digital communication sys-
tems. Sampling theorems, pulse amplitude, duration, and distortion; Quantization, coding, and pulse code modula-
tion. Generalized digital signals and carrier modulation line with digital waveforms. Delta, adap-
tive delta, delta-sigma, and delta PCM systems. Prereq: 3100.

4250 Elements of Network Synthesis (3) Energy relations for linear networks. Quadratic forms and real functions; properties and tests. Synthes-

4370 Introduction to Feedback System Design (3) Mathematical formulation of control systems, steady-state error and error constants, root-locus method; optimum gain adjustments; compensa-
tion networks, feedback amplification, and system design. Prereq: 3720. Lab option.

4410 Power System Components and Control (3) Analysis of power system components and their interconnection. Studies in control of power and frequency systems as well as voltage and reactive power. Prereq: 3060.

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

4430 Transmission, Distribution, and Protection (3) Study of power transmission and trans-
mission; consideration of over-voltages and insula-
tion requirements; system protection against faults. Prereq: 4420.


4480 Plasma III (3) Macroscopic plasma equa-
tions, particle orbits, interactions, oscillations and waves. Prereq: 3180.


4500 Electro-optic Detection and Instrumenta-
tion (3) Sensitivity, resolution (frequency re-
sponse) and noise figure. Comparison of various techniques, engineering data for both spatial recording media (e.g., photographic emulsions) and tem-
oral 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 scattering, optical data process-
ing, holographic interferometry). Prereq: 3060.

4540 Antennas and Propagation (3) Dipole and linear antennas, arrays and other simple anten-
nas. Antenna radiation, wave propagation, and diffraction of electromagnetic waves. Prereq: 4540 and 3190.

4570 Electromagnetics Acoustics (3) Reproduction of monophonic and stereophonic sound, micro-
phones, loud speakers, disc recording, magnetic record, film recording; acoustics of studio, auditoriums.

4600 Instrumentation Transducers and Signal-
Conditioning Electronics (3) Various sensors and transducers utilized for parameter measurement. Use of the operational amplifier in signal-condi-
tioning; design examples such as active filters, amplifiers, attenuators, and function generators. Analysis of interfacing problems between microcomputer and signal-conditioner. Applications to environments monitoring instrumentation. Prereq: 3120 or 3830.

4610 Analog-Digital Systems (3) Principles of analog computing components. Applied to ana-
log computing to include problem set-up and solution. Design of analog-to-digital and digital-to-analog converters, dividers and function generators are developed. Presents comparators, digital to analog conver-
tion, and other topics in digital systems. Prereq: 3180 and 3830. 3 hrs including biweekly lab.

4620 Sequential Machine and Digital System Theory (3) Considers design aspects of pulse-
mode switch, and level-mode sequential circuits. Theory and characteristics of one- and two-dimensional iterative networks. Design of large scale digital systems using MSI and SSI tech-
niques. Introduces principles of reliability and error detection in digital systems. Prereq: 3060, 3190. 3 hrs including biweekly lab.

4630 Digital System Organization and Design (3) Considers system organization of digital sys-
tems including minicomputer and micropro-
cessor architectures and comparisons. Character-
istics of ALU and CPU structures, storage systems (RAM, ROM, and PROM building blocks), and input/output systems are developed. Control unit organization to include serial-parallel modes of operation, synchronous-asynchronous time se-
dencing and microlotyping of control func-
tions. Prereq: 3180. 3 hrs including biweekly lab.

4650 Bioelectric Instrumentation (3) Nature and origin of bioelectric potentials, transducers, amplification, frequency concepts, recording systems and noise problems.

4660 Electronic Power Amplifiers (3) Transistor and vacuum-tube power amplifiers; distortion, thermal considerations; r.f. power amplifiers; oscillators. Prereq: 3550. 3 hrs including biweekly lab.

4690 Communications Electronics (3) Oscillators, modulation and demodulation; basic communica-
tions systems. Prereq: 3830. 3 hrs including biweekly lab.

4700 Switching Circuits (3) Pulse amplification, gating circuits, multivibrators, wave shaping cir-
cuits, trigger circuits. Prereq: 3010, 3830. 3 hrs including biweekly lab.

4740 Integrated Circuits (3) Processing and fabri-
cation of active and passive components for monolithic and hybrid circuits. Design of linear and digital and large scale integration. Prereq: 3830.

4780 Synchronous Machines (3) Development of 2-axis model for synchronous machines. Applica-
tions to analysis of steady state and trans-
ter operation. Excitation and governor control. Prereq: 3090.

4790 Electromechanical Components of Control Systems (3) Characteristics and analysis of elec-
tromechanical devices. Applications of single phase induction motors, servomotors, tachometers, synchros. Dynamic behavior of d.c. machine systems. Applications in industrial proc-
ess control. Prereq: 3080 and 3720.

4800 Hardware-Software Interface in Minicomputer and Microprocessor System Design (3) Presents minicomputer and microprocessor in-
terface design. Hardware-software interaction and trade-off. Priority interrupt structures are discussed and utilization analysis is developed. Project oriented, contract course. Completion of two projects, one utilizing a mini-
computer and the other a microcomputer, are minimal course requirements. Prereq: 3180.

4810 Discrete-Data Systems (3) Introduction to analysis and design of discrete data control sys-
tems using frequency domain techniques. Real-
time digital filtering techniques; application of digital computers in closed-loop feedback sys-
tems.

4820 Introduction to Pattern Recognition (3) Role of pattern recognition within framework of artif-

cial intelligence. Topics dealing with the design of learning and adaptive machines. Typical appli-
cations of pattern recognition to problems of practical significance. Computer simulation of elementary pattern recognition problems. Pre-
5000 Thesis
5040-50-60 Electrical Engineering Research (3, 3, 3)
5070-40 Modern Transform Methods (3, 3) L
5120 Network Synthesis and Design (3) Frequency domain and time domain synthesis of network functions; realization of one-port and two-port networks by R, L, and C elements. Approximation problem and filter design; computer aided techniques. Prereq: 5070 or equivalent.
5150 Bioengineering Systems I Models, Systems Analysis and Simulation (3) Modeling techniques applied to physiological systems. System identification, estimation, and storage are investigated. Analog and digital simulation of biological systems. Prereq: 4370 or consent of instructor.
5180 Bioengineering Systems II Bioelectric Phenomena (3) Electrical phenomena associated with biological systems as stimuli and responses. Quantitative theories in neurophysiology and electrocardiography. Prereq: 4860 or consent of instructor.
5190 Bioengineering Systems III Instrumentation and Analysis (3) Process by which information is gathered and transmitted from biological system under test and process by which this information is received, analyzed, and interpreted. Error theory and system limitations. Prereq: 4610-20-30.
5210-20 Advanced Electrical Machinery (3, 3) Fundamental processes of electromechanical energy conversion; application in conventional devices. Differential equations for rotating machines, Park's transformation and two-axis model, transient behavior of isolated and interconnected rotating machines. Prereq: 4780 or equivalent.
5230 Advanced Electrical Machinery Applications (3) Linear motors; pole amplitude modulation and other speed control techniques; variable frequency operation. Prereq: 5210.
5240-50-60 Control Systems (3, 3, 3) Analysis and design of continuous and discrete control systems. Computer control systems using classical and modern techniques. Feedback theory; system modeling; stability analysis; system response analysis; design of estimator and observer; system compensation. Emphasis on control aspects of control systems. Coreq: 5070 or equivalent.
5310 Basic Requirements for Plasma Fusion (3) Historical study of fusion systems in nature. Lawson break-even criterion, inertial fusion systems—hydride and eutectic, and electron-beam fusion. Magnetically-confined plasma systems, tokamak, mirror system, and exotic systems. Confinement, stability, and heating. Possibility of fusion-fission hybrids. Prereq: Consent of instructor or plasma engineering or plasma physics background or employment in fusion work.
5330 Engineering of Fusion (3) Materials in a theta pinch. Principles of vacuum design. Confinement, stability, and heating. Possibility of fusion-fission hybrids. Prereq: Consent of instructor or plasma engineering or plasma physics background or employment in fusion work.
5350 Properties of Quantum Devices (3) Optical resonant cavity theory and design: steady-state and Q-switched operation. Stable modes of oscillation and their relation to the photon statistics. Laser output power spectral line shape and noise characteristics. Operational characteristics of VCSEL's and VHE's. Applications in lasers and semiconductor diode lasers. Prereq: 5340 and Mathematics 4710 or equivalent.
5360 Application of Quantum Electronic Devices (3) Principles and applications of devices which make use of the quantum mechanical properties of atoms and molecules to perform electronic and optical functions. Prereq: 5310.
5410 Power System Networks (3) Sequence systems—standards. Prereq: 5070 or equivalent.
5430 Power System Stability and Control (3) Theory, latest devices, and engineering applications of power system stability and control for power system improvement. Prereq: Consent of department.
5460 Selected Topics in Power Systems (3) To meet special needs of students. Possible topics: power systems reliability, interconnected system theory, power plant operation, electrical transmission in power systems, and power system relaying. Prereq: Consent of instructor. May be repeated with consent of department.
5510-20-30 Linear Active Circuits (3, 3, 3) Analysis and design of linear amplifiers; mathematical treatment of active devices and equivalent circuits, sources of distortion, wide-band and pulse amplifiers, detailed treatment of feedback amplifiers using pole-zero and root-locus techniques. X-ray diagnostics. Spectroscopy and its limitations. Future possibilities. Prereq: Consent of instructor or plasma engineering or plasma physics background or employment in fusion work.
analysis as applied to response of systems to random inputs.

5740 Digital Processing of Signals (3) Analysis of discrete signals; sampling theorem and its implications; frequency-domain analysis of digital filters; time domain design of digital filters; quantization of signals; processing of digital signals; discrete Fourier transform. Prereq: 4100 or equivalent.


5770 System Identification (3) Various identification schemes; deterministic, stochastic, and hierarchical methods. 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 transmission lines and radio interference of high voltage transmission. Insulation coordination and protection. Design procedures for high voltage transmission. Prereq: 4410-20 or equivalent.


5820 Linear Antennas and Antenna Arrays (3) Hertzian dipole, linear antennas, impedance loop antennas, receiving antennas, linear arrays. Prereq: 5820.

5840 Aperture Antennas (3) Huygens principle, equivalence, support structures, antenna design and optimization. Prereq: 5840.

5850 Microwave Electronics (3) Space charge properties of microwave materials, waves in microwave circuits, guided waves, rectangular and cylindrical wave guides, radiation from current distributions. Prereq: 5850. Coreq: Mathematics 5610.

5860 Electromagnetic Wave Propagation (3) Wave propagation in isotropic and anisotropic media, transmitted power, stored energies, propagating and nonpropagating modes, orthogonality properties, boundary and radiation conditions, sources. Prereq: 5860.

5870 Introductory Microwave Networks (3) Circuit equivalents for n-port, junctions, obstacles, loading and fillings, one way and two way devices, directional devices, parameter measurements, reflection charts. Prereq: 5810. Coreq: Mathematics 5610.

5940-50 Advanced Small Computer Systems (3, 3) Real-time applications, memory and CPU organization, interface software, and peripheral devices. Microcomputer and microprocessor system are studied. Project-oriented, supported by hardware and software interface design. Prereq: 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: 5200 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: 5710 or equivalent.

6280 Modern Control System Design (3) Design of optimum control systems via variational calculus, maximum principles, dynamic programming, and gradient methods. Prereq: Mathematics 5240-40 or equivalent.


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


6650 Advanced Antenna Theory (3) Cylindrical dipole, Hallen's equation, King's integral equation, current distribution, terminal impedances, mutual impedances between several dipoles. Prereq: Mathematics 5610 and 4500.

6660 Electromagnetic Diffraction and Scattering (3) Diffraction of electromagnetic waves by spheres and cylinders, ground wave propagation problem, modern approximate methods, creeping waves. Prereq: Mathematics 5810 and 4500.


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

General policies and requirements of the Graduate School relating to admission, residence, languages, research, examinations, faculty advisory committee, and admittance 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 5000 and above, with at least 12 quarter hours of 6000-level courses, which constitute one or two areas of concentration selected by the student. The number of courses in this group to be taken will depend on the program selected by the student and the approval of his/her advisory committee.

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

4. A minimum of 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, for 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 and opportunities of biomedical engineering, and to provide basic terminology and background knowledge for further courses in the field. Subjects include anatomy, physiology, biophysical, mathematical models of body systems. Coreq: Mathematics 2840 or consent of instructor.

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

3430 Perspectives on Medical Ceramics (3) Details development of implant material from both an engineering and medical viewpoint. Demonstrates results of combined efforts of physician and biomedical engineer. Audiovisual aids and models are used to reinforce lecture topics. Prereq: 3410 or consent of instructor.

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

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

3700 Dynamics (4) Kinematics of rigid bodies; mass moments of inertia; coulomb friction; kinetics of rigid bodies using force, mass, acceleration; work-energy; impulse-momentum. Not for departmental graduate credit. Prereq: 2705 or Basic Engineering 1320, Mathematics 2840.

3710 Intermediate Dynamics (3) Three-dimen- sional dynamics of particles and rigid bodies; dynamics of deformable bodies with varying mass; LaGrange's equations. Prereq: 3700, Mathematics 2850.

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

4450 Orthopedic Biomechanics (3) Introduction to engineering principles and applications in orthopedics and rehabilitation. Topics include statics, Newton's laws of motion, stresses in simple sections, engineering materials, and biological materials. Prereq: Consent of instructor.

4500 Applied Mechanics for Life Scientists (4) Concise and broad coverage of basic principles and concepts of mechanics. Fundamental concepts, statics, vibrations, continuum mechanics and properties of materials. Applications in engineering and medicine. Prereq: Mathematics 1860 or consent of instructor.

4520 Biomedical Fluid Mechanics (3) Discusses objectives, review foundations and present developments in biomechanical fluid mechanics. Properties of human blood and blood vessels, determinants of cardiac performance, analysis and measurement of flow and pressure in arteries, noninvasive study of circulatory system, mechanics of microcirculation. Applications to areas of biomedical physics, method; introduction to fluid dynamics of heart assist devices. Prereq: 4500 or a course in fluid mechanics or consent of instructor.

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

4530 Biomembranes (3) Discuss objectives, review foundations and present developments in areas of mechanical properties of living tissues, biomechanics of injury and prostheses, material compatibility of prosthetic devices, and biomedical mechanical 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: 3310 and Metallurgical Engineering 2110. (Same as Metallurgical Engineering 4540.) 3 hrs or 2 hrs and 2-1/2 lab.

4550 Experimental Stress Analysis (3) Basic concepts: theory, techniques, and instrumentation of resistance strain gages; theory and techniques used for the measurement of other stress analysis methods. Prereq: 3310, Electrical Engineering 2030 or 3110. 2 hrs and a 3-hr lab.

4620 Dynamic Data Acquisition (4) Instrumentation of measuring systems for dynamic events and responses; signal conditioning; oscilloscopes, oscillographs, and magnetic tape recording; telemetry and data transmission; data processing. Prereq: 3311, 3700, Electrical Engineering 3120. 3 hrs and a 3-hr lab.

4630 Introductory Photomechanics (3) Introduc- tory course to photography, including general method, Moire method, interferometry, and holography. Prereq: 3310, Physics 2320. 2 hrs and a 3-hr lab.

4710 Fundamentals of Vibrations (3) Free and forced vibrations of damped and undamped lumped parameter systems; energy methods. Prereq: 2720, Mathematics 2830.


4810-20 Engineering Analysis (4,3) Integration of fundamental physical laws and mathematical methods of analysis with emphasis on application to realistic engineering problems. Prereq: 3110, 3311, and Mathematics 3150.

4850 Elementary Structural Matrix Methods (Same as Civil Engineering 4850 and Architecture 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
5750 Orbital Mechanics (3) Planetary, satellite, and astronomical orbits and trajectories; orbital perturbations; classical principles of minimization. Prereq: 5710.

5800 Introduction to Continuum Mechanics (3) Fundamentals of mechanics of solids and fluids; Cartesian tensors; stress, deformation, and flow in continuum mechanics; constitutive equations; applications to solids and fluids. Prereq: 3130 and 3311 or equivalents, Mathematics 4610.


5860 Introductory Finite Element Methods (3) General finite element procedure; convergence requirements; programming concepts. Stress concentration; plane stress, plane strain. Prereq: 5110 and 5860.

5810 Finite Element Structural Analysis (3) (Same as Civil Engineering 5180.)

5220 Mechanics of Viscous Flow (3) Viscous force on deformable bodies; application of Navier-Stokes equations; numerical methods of solutions; stress-optic methods of laminar flow analysis. Prereq: 3710 and Mathematics 4610. (Same as Chemical Engineering 5610.)


5410-20 Theory of Elasticity (3, 3) Stress, strain in three dimensions; torsion and bending of prismatic bars; axisymmetric stress distribution; stress concentration; plane stress, plane strain. Prereq: 5800.

5430 Thermal Stresses (3) Heat conduction; thermoelastic equations; thermal stresses in beams, rings, plates, and shells; thermal buckling and creep concepts; Laminar and turbulent boundary layer flow; inviscid and aerodynamic flows; incompressible viscous flows with separation and recirculation. Prereq: 5110 and 5860.

5440 Theory of Linear Viscoelasticity (3) Linear viscoelasticity of solids; quasistatic problems; vibration problems; stress and strain relaxation; relaxation methods in linear viscoelasticity. Prereq: 5600.


5560-40 Photoelasticity (3) 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, three-dimensional photoelasticity. Prereq: 3311, Mathematical Methods 4611, and consent of instructor. Prereq: 5460: 2 hrs and 3 labs.

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

5730 Advanced Vibrations (3) Vibrations of multiple degree of freedom, forced response, driven systems, and interactive and approximate solutions. Introduction to random vibrations. Prereq: 4710 and 4860.

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 Mathematics 4450.

5750 Orbital Mechanics (3) Planetary, satellite, and astronomical orbits and trajectories; orbital perturbations; classical principles of minimization. Prereq: 5710.

5800 Introduction to Continuum Mechanics (3) Fundamentals of mechanics of solids and fluids; Cartesian tensors; stress, deformation, and flow in continuum mechanics; constitutive equations; applications to solids and fluids. Prereq: 3130 and 3311 or equivalents, Mathematics 4610.


5860 Introductory Finite Element Methods (3) General finite element procedure; convergence requirements; programming concepts. Stress concentration; plane stress, plane strain. Prereq: 5110 and 5860.

5810 Finite Element Structural Analysis (3) (Same as Civil Engineering 5180.)

5220 Mechanics of Viscous Flow (3) Viscous force on deformable bodies; application of Navier-Stokes equations; numerical methods of solutions; stress-optic methods of laminar flow analysis. Prereq: 3710 and Mathematics 4610. (Same as Chemical Engineering 5610.)


5410-20 Theory of Elasticity (3, 3) Stress, strain in three dimensions; torsion and bending of prismatic bars; axisymmetric stress distribution; stress concentration; plane stress, plane strain. Prereq: 5800.

5430 Thermal Stresses (3) Heat conduction; thermoelastic equations; thermal stresses in beams, rings, plates, and shells; thermal buckling and creep concepts; Laminar and turbulent boundary layer flow; inviscid and aerodynamic flows; incompressible viscous flows with separation and recirculation. Prereq: 5110 and 5860.

5440 Theory of Linear Viscoelasticity (3) Linear viscoelasticity of solids; quasistatic problems; vibration problems; stress and strain relaxation; relaxation methods in linear viscoelasticity. Prereq: 5600.


5560-40 Photoelasticity (3) 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, three-dimensional photoelasticity. Prereq: 3311, Mathematical Methods 4611, and consent of instructor. Prereq: 5460: 2 hrs and 3 labs.

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

5730 Advanced Vibrations (3) Vibrations of multiple degree of freedom, forced response, driven systems, and interactive and approximate solutions. Introduction to random vibrations. Prereq: 4710 and 4860.

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 Mathematics 4450.
engineering core, 9 hours of technical methods electives, 9 hours of industrial engineering design electives and a 9-hour thesis or design project.

4060 Material Requirements System Design (3) Theory and applications of forecasting, production and inventory control, order scheduling, materials management, and systems design and implementation. Design of the material requirements process as an integrated design effort. Prereq: 3510. Not available for graduate credit for industrial engineering students.

4300 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 methods, trend estimation and time-series analysis, Delphi methods and other selected industrial forecasting methods. Prereq: 4060.

4150 Project Control with CPM and PERT (3) A study of project planning and control based primarily on "critical path" techniques, including resource allocation, time-cost trade-off algorithms, multi-project control, and computer programs. Prereq: 3430.

4160 Materials Handling (3) Analysis and planning for the overall problem of moving, packaging, storage, and protection of equipment, order comparison and selection; cost analysis. Prereq: 3220, 4520, and Engineering Science and Mathematics 2860 and Engineering Science and Mechanics 2720.

4220 Scheduling Systems (3) Performance measures for job shop and flow shop scheduling, including both static and dynamic conditions, as well as techniques for generating production schedules. Deterministic and probabilistic dispatching conditions. Prereq: 3520.

4250 Work Measurement Applications (3) Application of learning curves, queuing theory, standard data methods and techniques to the design of industrial work situations. Prereq: 3220.

4520 Engineering Economy (3) Methods and problems in valuation of capital outlays, investment, and cost of replacement of equipment. Includes the use of annuity and present value functions in evaluating capital recovery, economic life of equipment, and rate of return on investment. Not available toward degree requirements. May be repeated. S/NC option available.

4530 Case Studies in Engineering Economy (3) Extension of basic engineering economy principles to evaluate the economic feasibility of business plans by the use of the techniques of valuation of capital outlay, economic life of equipment, and rate of return on investment. Prereq: 4520.

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


4830 Health Systems Engineering (3) Hospital management systems and methods by which they may be improved. Application of industrial engineering principles and techniques. Prereq: 3220.


4910-20-30 Special Industrial Engineering Topics (3, 3, 3) Consent of instructor. May be repeated. 

4950 Industrial Safety (3) Development of organizational and managerial systems required for the design of industrial work situations. Prereq: 3520. 

5002 Non-Thesis Graduation Completion (3-15) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities and/or faculty before degree is completed. May not be used toward degree requirements. May be repeated. S/NC option.

5110 Work Design (3) Advanced methods analysis of design and improvement of work systems, human factors, workers' response and management tasks. Emphasis on work sampling and human factors in system design. Prereq: 5360 or 5370.

5210 Advanced Work Measurement (3) Characteristics of predetermined time systems, application of work measurement and time study or work methods and design. 

5220 Advanced Work Measurement (3) Characteristics of predetermined time systems, application of work measurement and time study or work methods and design.

5240 Facilities Planning and Design (3) Modern materials handling techniques, computer-aided layout techniques, applications of operations research and other economic factors in design of manufacturing facility. Prereq: Production facilities planning or consent of instructor.


5260 Information Systems Design (3) Engineering concepts of information systems, information objectives and decision criteria. Application and interpretation of data collected in application of industrial engineering techniques. Prereq or coreq: Statistics 3450.

5420 Reliability Engineering (3) Reliability concepts, failure distribution, equipment failures, equipment reliability, time dependent and Markov dependent systems, Maintenance data analysis and replacement problems with emphasis on uncertainty. Prereq: Statistics 3450.


5900 Design Project (1-9) Industrial engineering topic to fulfill design project requirement in nonspecific program or limited to industrial engineering students in non-thesis program. May be repeated. Maximum 9 hrs.

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


6520 Operations Research Models in Engineering Economy Decisions (3) Traditional capital planning and budgeting techniques; operations research application to capital, tax, risk and capital budgeting problems. Mathematical programming and computer simulation, Interrelated projects, uncertain cash flows and choice of appropriate evaluation criteria. Prereq: 5520, 5710.

6700 Nonlinear Programming (3) Optimization techniques for static and dynamic nonlinear systems subject to various constraints. Application of nonlinear programming to solve nonlinear optimization problems. Variable metric methods, search methods, constrained nonlinear programming, and penalty function methods. Prereq: 5700.

6730 Dynamic Programming (3) Solving multistage optimization problems as sequence of single-stage optimization problems. Computational and theoretical aspects of dynamic programming.
gramming. Decision making under certainty and risk. Prereq: 5710.

6740 Advanced Topics in Optimization of Dynamic Systems (3) Multi-stage optimization theory, linear programming, dynamic programming, adaptive optimization theory, and other selected topics. Prereq: 6730.

6910 Advanced Topics in Industrial Engineering (3) Will cover topics not covered in other graduate courses. A forum for advanced graduate students to study individually or in group as appropriate. Prereq: Graduate standing and consent of instructor. May be repeated with consent of department.

Mechanical and Aerospace Engineering

MAJORS

DEGREES

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

Professors:

M. W. Milligan (Head), Ph.D. Tennessee, P.E.;
J. F. Bailey*, Ph.D. Lehigh, P.E.;
A. J. Edmondson, Ph.D. Texas A. & M., P.E.;
B. H. Goethert*, Ph.D. Berlin, Germany;
J. W. Hodgson, Ph.D. Georgia Institute of Technology, P.E.;
D. M. Johnson, M.S., Ph.D. New Mexico State;
R. L. Maxwell, Ph.D. Case Western Reserve, P.E.;
F. H. Speckhart*, Ph.D. Georgia Institute of Technology, P.E.;
J. L. Wu*, Ph.D. California Institute of Technology; Y. L. Wu*, Ph.D. California Institute of Technology; R. L. Young*, Ph.D. Northwestern, P.E.

Associate Professors:

S. E. Becker, Ph.D. North Carolina State, P.E.;
G. W. Brown, M.S., Ph.D. Tennessee, P.E.;
S. C. Hauk,* Ph.D. Indian Institute;
W. Frost*, Ph.D. Washington (Seattle);
E. G. Kekosh, Ph.D. Oklahoma State;
R. J. Kraner, Ph.D. Oklahoma;
R. L. Reid, PrD. Southern Methodist, P.E.;
F. Stahrholz*, Ph.D. Oklahoma;
J. W. White, Ph.D. Stanford;
H. J. Wilkerson, Ph.D. Tennessee, P.E.

Assistant Professors:

R. Arumilli, Ph.D. Virginia Polytechnic Institute;
J. A. Eyer, Ph.D. Purdue, P.E.;
J. K. Koester*, Ph.D. California Institute of Technology;
J. R. Maus, Jr.*, Ph.D. North Carolina State;
M. Parang, Ph.D. Oklahoma; G. V. Smith, Ph.D. Pennsylvania State, P.E.

GRADUATE STUDY PROGRAMS

Graduate programs in Mechanical Engineering or Aerospace Engineering are available to the degrees of Master of Engineering, Master of Science, and Doctor of Philosophy with concentrations in solar energy, energy conversion, power generation, machine design and dynamics, aerodynamics and gasdynamics, aeroacoustics, stress analysis, propulsion, heat transfer, fluid mechanics, and thermodynamics. 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'S PROGRAM OPTIONS

Three program options are available:

A. 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 to qualified graduates of other curricula who satisfy the necessary prerequisites.

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

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.

5. Participation in the department 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-engineering 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, energy conversion, including conservation schemes, emphasis on the resources-environment-man interaction associated with energy. Offered only for non-engineering students.

3110 Applied Engineering Thermodynamics (3) Energy and thermodynamics: heat, work, energy transformations; thermodynamic properties; applications to engineering problems.

3311 Engineering Thermodynamics (3) Energy and thermodynamics: heat, work, energy transformations; thermodynamic properties.

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

4140 Fluid Flow (3) Development of continuity, momentum and energy principles for fluid sys-
tems; 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) Fundamental principles of thermodynamics and transport systems, numerical solutions, and applications to engineering design. To be taken in sequence.

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

3620 Mechanics of Machinery—Dynamics (3) Applications of Newton's laws, work, energy, and impact to machinery. Force analysis of mechanisms, balancing, gyroscopic effects, flywheels. Prereq: 3610.


3650 Introduction to Machine Design (3) Ductile-brittle behavior of materials under static and cyclic loading. Stress concentration, design factors and theories of failure. Changes in material behavior in processing and fabrication. 2 hrs and 1 2-hr lab.

3660 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 the conversion of energy forms and their application to power plants.

4160 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 or analysis, design, performance evaluation.

4180 Energy Production and Utilization (3) Thermodynamic constraints on energy production, conversion, and utilization; 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.

4220 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 measurements of force, length, time, temperature, pressure, transport rate, and physical properties, and analog computer solutions. Not for departmental graduate credit.

4520-39 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; plastic production; metalurgy.

4622 Tool Design (3) Principles underlying tool and die design, 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 costs.

4625 Manufacturing Process Engineering I (3) Product specification: dimensional analysis of size and form; true position tolerance theory; tolerance analysis; and workpiece 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) Application 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, mechanical properties, environment, temperature, manufacturing technology and cost.

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

4680 Machine Elements (3) Application of strength and properties of materials, design factors, theories of failure to design of machine elements, springs and shafting, selection of chains and belts.

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

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

4720 Thermal Environmental Systems (3) Design 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.

4740 Solar Energy Utilization (3) Nature and availability of solar radiation; review of selected heat transfer topics pertinent to solar energy collection and use; design analysis of solar energy collectors and methods of storage; selected applications.

4810 Internal Combustion Engines (3) Thermochromatic 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.

4910-39-50 Selected Topics in Mechanical Engineering (3, 3, 3) Problems related to development and practice in mechanical engineering.

5000 Thesis

5002 Non-Thesis Graduation Completion (3-15) Required for the non-thesis student not otherwise registered during any quarter when such a student uses university facilities. May not be used toward degree requirements. May be repeated. 5/NC only.

5110 Conduction Heat Transfer (3) Analysis of steady state and transient heat conduction by analytical and numerical techniques. Prereq: 3910, 4420 and Mathematics 3150.

5120 Convection Heat Transfer (3) Equations of viscous fluid flow; energy equation; convection analysis of internal and external flows including effects of variable heat flux, surface temperature, and fluid properties. Prereq: 5510 or equivalent.


5140 Phase Change Heat Transfer (3) Prereq.

5210 Classical Thermodynamics (3) Macroscopic thermodynamics with emphasis on First and Second Law analyses, equilibrium criteria, and thermodynamics of phase relationships. Prereq: 3330.

5220 Microscopic Thermodynamics (3) Thermodynamic properties, kinetic theory and statistical mechanics. Prereq: 5210.

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

5210 Intermediate Fluid Mechanics (3) Vector descriptions in fluid mechanics; derivation of basic equations; two-dimensional potential flow; viscous flow and emphasis on boundary-layer theory. Prereq: 3410.

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

5510-30-40 Mechanical Engineering Design (3, 3, 3) Design of mechanical engineering units and systems.


5610-20-30 Experimental Stress Analysis (3, 3, 3) Theory of elasticity and experimental methods, photoelasticity, strain gauges, lacquer coatings.

5640-50-60 Advanced Machine Design (3, 3, 3) Design of bearings, gears, shafting; lubrication.

5670-30-60 Dynamics of Machinery (3, 3, 3) Dynamics of machinery; vibrations; balancing; flywheels and governors.

5710 Metal Machining (3) Analytical approach to mechanics of machining. Basic phenomena—plastic flow, fracture, friction and wear. Prereq: 3560, 3440, and Mechanical Engineering 2110.

5800 Transfer Matrix Methods in Elastomechanics (3) Application of transfer matrix methods to static and dynamic lumped parameter electric systems in mechanical engineering. Calculation of forced response, mode shapes, and natural frequencies of beams and rotating shafts having complex end conditions. Balancing of rotating shafts. Accuracy and numerical considerations. Prereq: Graduate standing in engineering and consent of instructor.


5840-50-60 Turbomachinery Systems (3, 3, 3) Design, development, and systems integration of turbomachinery components, efficiencies and off-year graduate standing and consent of instructor.

5900 Selected Engineering Problems (3-9) Selection of problems to fulfill requirement of Problems Program. Enrollment limited to students in Problems Program. Prereq: Consent of advisor. May be repeated. S/NC only.

5950 Seminars (1) All phases of mechanical engineering, including reports on current research at The University of Tennessee, Knoxville. May be repeated. S/NC only.

5990 Special Topics in Mechanical Engineering (1-3) May be repeated.

6000 Doctoral Research and Dissertation

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

6130-40 Advanced Radiation Heat Transfer (3, 3) Radiation heat transfer in absorbing, emitting, and scattering media; interaction of thermal radiation with conduction and convection heat transfer; radiation and combined processes. Prereq: Consent of instructor.

6220-0-20-30 or Mechanical Engineering 5310.

6310 Dynamics (3) Newton's law: work-energy impulse-momentum, Lagrange equations, central force, gyroscopic effects. Applications to aerospace systems.

6320 Mechanical Vibrations (3) Free and forced vibrations of single and multiple degree vibrating systems, balancing of rotating machinery.

6360-40 Structural Analysis of Aerospace Vehicles (3, 3) Fundamentals of structural analysis as applied to configurations of aerospace interest. Introduction to aeroelasticity phenomena. Must be taken in sequence.

6410 Aerodynamic Fundamentals (3) Atmophere, dynamics and thermodynamics of perfect gases, fluid flow types, airfoil theory, wing theory, drag. For non-aerospace engineering majors only.

6420 Aircraft Propulsion and Performance (3) Propellers, propulsion systems for aircraft, static performance and special performance problems, maneuvering, control surfaces, stability and control. For non-aerospace engineering majors only.

6420 Compressible Flow (3) One-dimensional internal flow; shock and expansion waves; friction and nonadiabatic flow.

6450 Astronautics (3) Propulsion, trajectories, guidance, control, and atmospheric reentry of space vehicle systems.

6520 Propulsion (3) Principles of propulsion devices; turbojet, ram-jet, and rocket engines.

6560 System Design (3) Synthesis of aerospace system. Design report on the system.

4471-81 Experimental Aerodynamics (3) Experimental techniques with laboratory experiments; characteristics of laminar and turbulent boundary layers; interaction of thermal radiation on the boundary layer; forced vibrations, stability, and control characteristics. Prereq: 4210 and 4420. May not be used toward degree requirements. May be repeated. S/NC only.

4510 Airplane Performance (3) Introduction to airflow and wind tunnel testing; performance characteristics; theory and design of control surfaces; stability.

4520 Aerospace Systems (3) Current problems in aerospace science; topics in science and engineering needed for an understanding of the several areas of aerospace science.

5000 Thesis

5002 Non-Thesis Graduation Completion (3-15) May be repeated.

5110 Fundamentals of Aerodynamics (3) Kine- matics and dynamics of perfect fluids; potential flow about bodies. Applications to aerospace vehicles throughout flight speed range. Dynamic stability; heat protection systems. Prereq: Consent of instructor.

5120 Experimental Methods in Fluid Mechanics (3) Experimental techniques with laboratory experiments; hot wire anemometry and turbulence measurements, flow visualization, wind tunnel tests, particle image velocimetry, boundary layer measurements, and similarity parameters, linear and nonlinear single degree of freedom systems. Prereq: Consent of instructor.

5210-0-20-30 Mechanical Engineering 5110, Mathematics 4550.

5220-0-20-30 or Mechanical Engineering 5310.

5240 Dynamics (3) Newton's law: work-energy impulse-momentum, Lagrange equations, central force, gyroscopic effects. Applications to aerospace systems.


5250-20-40 Aerodynamics of Compressible Fluids (3, 3) One-dimensional flow; waves, small-perturbation theory, slender body theory; similarity rules, method characteristics. Prereq: 4210 for 5210 and 5210 for 5220.

5240 Dynamics of Viscous Fluids (3) Equations of viscous fluid flow; laminar and turbulent flow; transition; separation; boundary layer theories; exact and approximate solutions. Prereq: Mechanical Engineering 5310 or equivalent.

5250 Introduction to Hypersonic Flow (3) Slender body flow; similarity; Newtonian theory; blunt body flow; hypersonic shock waves; rarefied gas flow. Prereq: 5240.

5280 Selected Topics in Aerodynamics (3) Transonic, supersonic, and hypersonic flow theories. May be repeated. Maximum 9 hrs.


5310 Magnetoaerodynamics (3) Electromagnetic flow theory; chemical kinetics, thermodynamic and thermophysical properties of gas and liquid, governing equations and applications. Prereq: 4420 and Mathematics 4710.

5340-50 Atmospheric Entry (3, 3) Motion and heating along ballistic and lifting trajectories; dynamic stability; heat protection systems. Prereq: 5220. Recommended: 5240.

5450-40 Transonic Flow (3, 3) Theoretical and experimental aspects of transonic flow. Topics include transonic flows and delineation of specific problems—nonlinear nature of flow, strong viscous effects, interaction, development of small disturbance equations and similarity parameters, shock-wave in transonic flow and assumptions of inviscid motion. Prereq: 5450.


5560 Vertical or Short Take-Off and Landing Aircraft (3) Analysis of performance and inherent stability characteristics of vertical take-off, lift, tilting wing, vectored lift and jet vertical riser type aircraft. Problems encountered in vertical and transition flight modes. Simulation and advanced flight testing, High lift airfoils. Automatic controls. Prereq: 5550.


5610 Applied Aeroacoustics (3) Energy flow in aco-oustical space; sources of sound propagation in nonhomogeneous moving medium, sound waves due to turbulence, noise in mechanical systems, sound propagation and absorption of sound in ducts, instrumentation and measuring techniques. Prereq: Consent of instructor.

5620 Aeroacoustics (3) Special topics and recent research results in field of aeroacoustics. Turbo-machinery noise, jet noise, and general theoretical developments, empirical equations. Prereq: 5610.


5810 Mechanics of Materials (3, 3) Mechanics and thermodynamics of perfect gases, fluid flow types, airfoil theory, wing theory, drag. For non-aerospace engineering majors only.


5820 Air Vehicles (3) Current capabilities and future requirements for air transport vehicles. Parameters significant for air vehicle type selection. Introduction of new generation air transport systems. For non-aerospace and non-mechanical engineering majors only. Prereq: 5810.


5900 Selected Engineering Problems (3-9) Selected problems in aerospace engineering to fulfill requirement of Problems Program. Enrollment limited to students in Problems Program. Prereq: Consent of advisor. May be repeated. S/NC only.
5950 Seminars (1) All phases of aerospace engineering, including reports on current research at The University of Tennessee, Knoxville. May be repeated. S/NC 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 magnetohydrodynamic equations. Alfven and shock waves, exact solutions for magnetohydrodynamic channel flows, one-dimensional model of channel flow, magnetohydrodynamic boundary layer. Prereq: 5310, Mathematics 5620.


6410 Physical Gas Dynamics (3) High-speed, high temperature flow of gas from molecular point of view; molecular concepts and simple kinetic theory; equilibrium properties of gases and gas mixtures; kinetic theory of gases, thermodynamics, and statistical mechanics. Prereq: 5220 and Mechanical Engineering 5220.

6420 Physical Gas Dynamics (3) Continuation of 6410. Mixtures in local thermodynamic and chemical equilibrium: physical and chemical basis of rate equations; flow with vibrational and chemical nonequilibrium. Prereq: 6410.


Nuclear Engineering

MAJOR DEGREES

Nuclear Engineering M.S., M.E., Ph.D.

Professors: P. F. Pasqua (Head), Ph.D. Northwestern, P.E.; T. W. Kerlin, Ph.D. Tennessee; J. E. Mott, Ph.D. Minnesota; J. C. Robinson, Ph.D. Tennessee; P. N. Stevens, Ph.D. Northwestern, P.E.

Associate Professors: H. L. Dodge, Ph.D. Tennessee, P.E.; J. B. Fussell, Ph.D. Georgia Institute of Technology, H. C. Roland, Ph.D. Tennessee; O. L. Smith, Ph.D.

Assistant Professors: E. M. Katz, Ph.D. Tennessee; L. Miller, Ph.D. Texas A & M, P.E.

The Department of Nuclear Engineering offers degrees leading to the Master of Science, Master of Engineering, and Doctor of Philosophy with concentrations in nuclear dynamics, nuclear reliability and risk, and nuclear safety.

THE MASTER’S 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 necessity of supplementary courses before he/she enters the program.

The student must complete a program of study consisting 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 an approved program of study which includes the following:

1. Thirty-six quarter hours of course work similar to the requirements for the regular Master of Science program (see above).
2. Twenty-four quarter hours of Nuclear Engineering 5980, Nuclear Engineering Practice. A student usually registers for 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 practice 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. Thirty-six quarter hours of course work, 18 of which must be in graduate nuclear engineering.
2. A minimum of 9 hours of design project, thesis, or 24 hours of 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 must be from the nuclear engineering discipline.
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 mathematics, computer science, basic sciences, or engineering sciences.
5. A candidate must pass a final oral examination on all work presented for the degree.

THE DOCTORAL PROGRAM

Students in the field of nuclear engineering desiring to study for the degree of Doctor of Philosophy must have a Bachelor of Science or Master of Science degree from a recognized university, with a major in engineering or physics, and present at least a B average. All candidates will be required to demonstrate general competence in the prerequisite course work in the field of nuclear engineering science, mathematics, and physics. At the same time, all candidates will be required to demonstrate special competence in nuclear engineering.

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 for doctoral dissertation research.
3. A minimum of 45 quarter hours in nuclear engineering courses numbered 5000 and above (or 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, computer science, or statistics in courses beyond nuclear engineering. Additional courses must be approved by the Ph.D. committee.

A graduate program leading to a degree of Doctor of Philosophy must have a major in nuclear engineering science, mathematics, and physics. The candidate must pass a written examination before he/she enters the program. The candidate must pass an oral examination on all work presented for the degree.

Admission to the Ph.D. program requires a minimum of 90 quarter hours of course work, 36 of which must be in graduate engineering, and a minimum of 18 quarter hours in the field of nuclear design. A candidate must pass a written or oral examination in the areas of nuclear engineering, mathematics, computer science, and physics. The candidate must pass an oral examination on all work presented for the degree.

A graduate program leading to a degree of Doctor of Philosophy must have a major in nuclear engineering science, mathematics, and physics. The candidate must pass a written or oral examination in the areas of nuclear engineering, mathematics, computer science, and physics. The candidate must pass an oral examination on all work presented for the degree.

6110-20-30 Introduction to Nuclear Reactor Theory (3, 3, 3) Nuclear structure; radioactive decay laws; neutron interaction; fission process, chain-reacting systems; diffusion equation; neutron diffusion; neutron moderation; neutron scattering; properties of plasmas; plasma containment; plasma diagnostics; thermonuclear deuterium-tritium (D-T) fusion. Prereq: Physics 3730 or consent of instructor.

6140 Thermonuclear Systems (3) Fusion reactions; properties of plasmas; plasma containment; plasma diagnostics; thermonuclear deuterium-tritium (D-T) fusion. Prereq: Physics 3730 or consent of instructor.

6210-20-30 Nuclear Engineering Laboratory (3, 3, 3) Radiography and counting instruments, counting statistics, half-life and decay schemes, gamma spectrometry, cross-section measurements, analog computer, diffusion properties of neutrons, critical loading experiments, control rod calibration, statistical weight, shielding, xenon poisoning, prompt critical reactivity, fissile density and adjoint flux. Prereq: physics 4730.


6470 Energy Transport (4) Development of differential equations, integration and conservation equations; conduction, convection, and radiation heat transfer; applications to nuclear reactor fuel element design and heat exchanger design. Prereq: mathematics 4610, non-nuclear engineering students only.

7470 Reactor Thermal Design (4) Hydrodynamics and heat transfer in boiling systems; boiling crises; fuel element thermal design, steam generator design. Prereq: 4710.
4730 Nuclear Reactor Design (3) First order reactor design, integration with non-nuclear heat transfer and power conversion system, economic evaluation; optimization procedures, description of typical systems. Coreq: 4120.

4810 Radiation Shielding (3) Types of radiation sources, gamma ray and neutron attenuation, biological effects of radiation, shield design. Prereq: Physics 3730, Mathematics 4550.

4820 Reactor Kinetics and Controls (3) Derivation of kinetic equations; basic kinetic parameters; transient response with feedback; control and protective systems. Prereq: 4110.

4840 Nuclear Reactor Safety (3) Presentation of reactor safety concepts and criteria; credible accidents; fission product release and transport; containment systems; accident analysis; engineered safeguards. Prereq: 4120.

4930 Nuclear Fuel Management (3) Discussion of problems associated with processing of nuclear materials; fuel cycle analysis; burnup calculations. Prereq: 4120.

5002 Non-Thesis Graduation Completion (3-15) 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. Coreq: Statistics 3450.

5210 System Dynamics (3) Transient analysis, Laplace transforms; frequency response, stability (linear and nonlinear), and sensitivity analysis by state variable methods. Dynamic analysis of distributed systems. Prereq: Consent of instructor.

5220 Reactor System Dynamics (3) Application of methods of general system dynamics to reactor systems. Modeling of neutronic and non-neutronic processes. Dynamics, stability, and control of zero power reactors and power reactor systems. Prereq: 5210, 4310 or equivalent.


5240 Reactor Instrumentation (3) Instrument components and systems for 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) System reliability analysis as applied to nuclear systems. Qualitative and quantitative methods. Coreq: Statistics 3450.

5510-20-30 Nuclear Systems (3, 3, 3) Various reactor types, flow diagrams, thermodynamic analysis, control methods, component descriptions of power systems using various reactor types and nuclear power economics. Prereq: 4610-20-30 or equivalent or consent of instructor.

5710-20-30 Nuclear Design (3, 3, 3) Analytical techniques for neutronic aspect of nuclear reactor core design. Multigroup discrete ordinate theory, multigroup PN theory, integral transport theory, perturbation theory, and others. Generation of required multigroup constants formulated with available point data and Nordheim treatment in slowing down region and gas kernel in 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; emphasis on LMFBR. Need for breeders; neutron physics and thermal characteristics of reactor core; development status of engineering components; fuel cycle cost analysis; safety; coolants other than sodium; world status of development.

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.

6100 Doctoral Research and Dissertation

6110-20-30 Selected Topics in Reactor Theory (3, 3, 3) Transport theory, control rod theory, and perturbation theory. Selected topics from literature. Prereq: Consent of instructor.

6140 Radiation Shielding (3) Advanced topics in radiation shielding. Monte Carlo techniques and space radiation problems. Natural space radiation, energetic particle radiators, dose conversion, probability. Selected neutron, gamma, and space-radiation shielding problems. Prereq: Consent of instructor.

6150 Reactor Dynamics (3) Special topics in reactor dynamics and control. Prereq: Mathematics 5630.

6740 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.
College of Home Economics

Lura M. Otland, Dean
Grayce E. Goertz, Associate Dean
Virginia S. Anagnost, Assistant Dean

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 for the interdisciplinary 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:
  - Consumer Studies and Housing: Public Policy
  - Crafts, Interior Design, and Housing
  - Food Science
  - Food Systems Administration
  - Nutrition
  - Textiles and Clothing

Non-Thesis Option:

- Requirements include Crafts, Interior Design, and Housing 5615 or Child and Family Studies 5170; Child and Family Studies 5700 or Planning 5100 or Economics 5340 or Agricultural Economics 4320; and Home Economics 5500. Three-hour course in research methods or statistics. Twenty-four hours in consumer studies or housing to include 9 hours of Child and Family Studies 5000 or Crafts, Interior Design, and Housing 5000.
- Consumer studies courses chosen in an area other than in home economics other than the area (consumer studies or housing) chosen above.
- Consumer studies courses to be selected from Child and Family Studies 5140, 5170, 5180, 5700, 5900, 5900; Crafts, Interior Design, and Housing 5120; Food Science 4040; Textiles and Clothing 5180; Agricultural Economics 4710; Economics 4340, 5050-60; Finance 5210-20; Political Science 5641, 5670-80, 5710; Library and Information Science 5250.
- Housing courses to be selected from Agricultural Mechanization 5110, 5610; Crafts, Interior Design, and Housing 4330, 5615, 5110-20-30; Planning 5360-40, 5450; Geography 5250.

Majors (includes minimum of 9 hours of 5000 courses) .............. 18 hrs
Collateral area(s) of study (includes minimum of 6 hours of 5000 courses) .............. 9 hrs
Minimum of 18 hours of 5000-level courses exclusive of thesis.................. 18 hrs
Total 45 hrs

In some instances two related collateral areas may be selected with 9 hours in each area and a minimum of 3 hours of a 5000 course in each.
- Collateral area(s) of study may be chosen in an area other than in home economics with the approval of the appropriate professors.
- An oral examination is required.

Note: Nine hours is the maximum credit allowed for special problems work and seminar work in any one area of home economics.

Non-Thesis Option:

- The non-thesis option is available for all majors listed under the thesis option and is the only option available for public health nutrition.
- In addition to the regulations of the Graduate School, the non-thesis program of study for all majors except Consumer Studies and Housing: Public Policy will 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 5000-6000-level courses is required in the program. Some majors may require 9 hours in one collateral area.

Twelve hours in an area of home economics other than the area (consumer studies or housing) chosen above.
Minimum 27 hours in and 9 hours outside College of Home Economics. Minimum of 27 hours 5000-6000 level courses and total minimum of 45 hours. Courses may be used to meet more than one requirement but all minimum requirements will need to be met.

**Requirements include those listed under the thesis option for the major in Consumer Studies and Housing: Public Policy except that 21 hours are needed in consumer studies or housing to include Home Economics 5050 (6 hours), or Child and Family Studies 5060 or Crafts, Interior Design, and Housing 5080.
Request for the non-thesis option must be made in writing to the department head. It must be filed before the end of the first term in residence.

DOCTORAL PROGRAMS

The doctoral program in Home Economics provides three options for study: interdisciplinary, food science, and nutrition. The interdisciplinary option is available in all departments in the College.

The doctoral program with a major in Home Economics requires:
1. A minimum of 96 quarter hours in courses beyond the Bachelor's degree exclusive of credit hours for the Master's thesis to include a minimum of 12 quarter hours of 6000-level courses.
2. Selection of an option and fulfillment of the requirements as supervised by the faculty committee.
3. The faculty committee for each doctoral student shall determine whether a reading knowledge of a foreign language is required.
4. Written preliminary examinations.
5. Doctoral research and dissertation (minimum 36 hours, maximum 48 hours) may be included in the 96 hours presented for the degree.
6. A final examination.

Option Requirements

Interdisciplinary option:
1. Home Economics 6110-20, 6210.
2. Twenty-four to 36 hours from at least two departments in the College of Home Economics representing one of the following concentrations:
   - Individual and Family Behavior as related to development and change throughout the human life cycle.
   - Emphasis may be on normal developmental processes, in individuals and families; socialization through childhood, adolescence, and adulthood; behavior in diverse environmental and cultural settings; interaction processes within families; community services and planning to meet development needs of individuals and families.

Physiological Development and Well-being in humans throughout the life cycle. Emphasis for particular age groups may be on: physiological response to nutrient intake, improvement of nutritional status through informed community action; cultural, economic and technological influences on food selection.

Environmental Factors in design, space planning, housing, food service systems, clothing, textiles, and crafts as they relate to human needs. Emphasis may be on the impact of: cultural, sociological, psychological, and economic change; technology through informed consumption; aesthetics in improving the quality of the environment.

Consumers' Economic and Social Well-being throughout the life cycle. Emphasis may be on the relationship between family structure and decision-making processes in the use of human resources; the effects of social, macro- and microeconomics and political decision-making patterns and other behavior; community programs to meet the socioeconomic needs of consumers.

3. Fifteen to 24 hours in cognitive or supporting courses (mainly from departments conducting research in the University) including courses to give sufficient competence in statistics or research methods needed for dissertation research. Additional courses will complement the option emphasis and dissertation research area.
4. Doctoral research and dissertation will be based on a problem within the interdisciplinary option concentration.

Food science option and food science with concentration in food systems administration:
1. Three hours in research methods from Food Science 5510 or 5520 or Food Systems Administration 5210; 6 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, 4000, 5000, 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 4 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, 4000, 5000, and 6000 courses in collateral area beyond the 9 hours may be substituted for 5000 and 6000 courses in nutrition).
   3. Minimum of 4 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 craftspersons. Cooperation with national and local craft organizations has so stimulated the work of craftpersons throughout the area that their work has gained national recognition. See also page 90.

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
Housing: Public Policy

DEGREES

M.S.
Ph.D.

Professors:

R. L. Hightower, Ph.D. Iowa; J. L. Kuppers (Head), Ph.D. Michigan State.

Associate Professors:


Assistant Professors:


4110 Student Teaching in Preschool Settings (6) Increasing responsibility for planning and guiding groups of young children under supervision of head teacher includes 2 hr weekly seminar. Prereq: 1500, 3110, 3210, 3210, Coreq: 4111.

4210 Family Finance (3) Analysis of alternative ways of meeting financial problems encountered during life cycle of family.

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 Development in Infancy (3) Development during prenatal period and first fifteen months of life, interaction between infant and environment. Review of research relating to childrearing practices and prediction of later behavior. Prereq: 2110 and Zoology 2030 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: 2110 or Home Economics 1510 or equivalent background in adult development or consent of instructor.

4350 Advanced Child Development (3) Survey of selected theories relevant to child development with emphasis on research literature and research methodology. Prereq 4 hrs psychology and 6 hrs child development or equivalent.
4420 Learning Experiences with Parents (3) Dynamics of parent-teacher interaction. Emphasis on a variety of techniques for developing communication and working relationships between parents and teachers through experiences in a variety of settings. Prereq: 3610 or 4110 or equivalent.

4430 Family Relationships (3) Interpersonal relationships among family members and societal roles. Prereq: 3510 or 3515.

4610 Child in the Community (3) Needs of children; community agencies meeting these needs; volunteer services to the welfare of children. Prereq: 2110 or Home Economics 1510 or equivalent.

4620 Administration of Programs for Young Children (3) Planning for staffing, housing, feeding, sheltering, and financing for day care of infants and young children, nursery school programs, and specialized programs for deprived preschool children. Prereq: 3110 or 3130 or 4110.

4630 Field Work in Child, Family and Consumer Studies (3-15) Opportunity for students to work in nursery schools or community agencies; focus on children, families, and/or community concerns. Hrs arranged. May be repeated. Maximum 15 hrs.

4710 Contemporary Developments (1-3) Student of special topics and study of selected topic(s) pertinent to the field; topics selected to be determined by students and instructor with departmental approval. Elective credit only. Prereq: Consent of instructor. May be repeated with departmental approval. Maximum 9 hrs.

4810 Afro-American Families (3) Historical background, contemporary family structure and relationships; emerging needs and programs. Prereq: 4 hrs in social sciences.

4830 Consumers and the Market (3) Dynamics of parental interaction. Emphasis on a variety of techniques for developing communication and working relationships between parents and teachers through experiences in a variety of settings. Prereq: 3610 or 4110 or equivalent.

5170 Consumer Economics (3) Consumer participation in total family life; survey and evaluation; students concentrate on type best suited to their experiences and future professional orientation. Prereq: 3 hrs family relationships, 3 hrs sociology, 2 hrs and 1 lab.

5130 Theory and Research on Human Sexuality (3) Cultural, social, and psychological dimensions of human sexuality. Major contributions from anthropological, sociological, and personality theory and research.

5180 Family Financial Consultation (3) Analysis of consumer decision making. Need for information and government protection of consumers. Special attention is given to consumer decision making, need for information and government protection of consumers.

5210 Theories of Child Development (3) 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 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. Major contributions from anthropological, sociological, and personality theory and research.

5410 Advanced Family Relationships (3) Problems in modern family life; individual adjustment, interpersonal relationships. Prereq: 3515, 4430, or consent of instructor.

5420 Parents and Children (3) Common problems of young children faced by parents and teachers: 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) Prereq: research literature; locating, abstracting, reporting research studies. Prereq: 5530 or equivalent.


5540 Preschool Curriculum Models (3) Analysis and evaluation of curriculum program models for young children. Prereq: 6 hrs child and family studies or preschool education.

5550 Supervision in Preschool Programs (3) Guidance of students working in nursery school and day care centers. Guiding students through seminar discussions, individual conferences, and observation of various evaluation techniques. Prereq: 6540. 3 hrs and 12-hr lab.

5610 Theories of Management in the Family Environment (3) Fundamental management concepts, 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. Prereq: 4410 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 child development and family relationships. Prereq: Consent of instructor. S/N only.


5800 Problems in Child, Family and Consumer Studies (1-3) Advanced study of child development and implications of recent developments in family planning programs, internship in planned parenthood programs and clinic. May be repeated. Maximum 9 hrs.

5860 Seminar in Child and Family Studies (1-3) Prereq Consent of instructor. May be repeated. Maximum 9 hrs.

5890 Seminar in Child and Family Development, Family Relationships and Consumer Studies (3) Issues and challenges to the student in the area of family, consumer, and community considerations. Prereq: Consent of instructor. May be repeated. Maximum 9 hrs.

6250 Advanced Topics (3) Individual study and group supervision of current problems. Prereq: Consent of instructor. May be repeated. Maximum 9 hrs.

6310 Individual and Family Development—Physiological Determinants (3) Family members' physiological potential for growth and development and to realization of human potential. Prereq: 6 hrs advanced child and family studies, 4 hrs nutrition, 4 hrs physiology, or equivalent.

6320 Individual and Family Development: Cogni- tion (3) Processes through which human individuals learn to recognize their world. Cognitive processes involved in development across life span. Prereq: 6 hrs in social sciences or equivalent.

6330 Individual and Family Development: Socialization (3) Processes of socialization throughout the life cycle. Family, society, and family behavior. Prereq: 5210, 5410, or equivalent.

6410 Theories of Family Interaction (3) Theories and concepts of family interaction. Critical evaluation of theoretical formulations of contemporary research on family behavior. Prereq: 5410 or equivalent.

6450 Conceptual Frameworks for the Family (3) Theoretical perspectives for understanding family interactions; exploration of applications of frameworks on theoretical and research levels. Historical to contemporary development of family studies. Prereq: 6 hrs child and family studies.

6540 Seminar in Programs for Infants and Preschool Children (3) Research related to programs for infants and young children. Various program models for education of infants and young children; methods of working with parents, and student training programs. Prereq: 5490 or equivalent.

6610-20 Applied Behavior Analysis in Natural Settings (3) Individual supervision and evaluation of applied behavior analysis in natural settings. Prereq: 5420 or consent of instructor.

6710 Elements of Consumer Choice (3) Analysis of consumer decision making as it pertains to consumer choice. Impact of affluence on consumers, and consideration of dynamic aspects of consumer behavior, including roles of aspirations, expectations, uncertainty and information. Prereq: 5170 or consent of instructor.

6720 Consumer Protection (3) Consumer protection and regulation agencies, standards, information, disclosure and other consumer protection legislation. Assumptions involved in these efforts and responsibilities of practitioners. Prereq: 5170, 5190 or consent of instructor.

Crafts, Interior Design, and Housing*

MAJORS
Crafts, Interior Design, and Housing
M.S. Consumer Studies and Housing
M.S. Home Economics
Ph.D.

Professor: R. G. Blakemore (Head), Ph.D., Florida State University.

*The Crafts program is under revision.

Contact the Department of Art for further information.
College of Home Economics

Associate Professor: W. Moran, M.S. Wisconsin.

Assistant Professors: A. K. Farkas, Ph.D. Minnesota; K. Tepel, M.S. Massachusetts.

To be admitted to the Graduate School in the craft program a student must have a professional introduction to craft 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 concepts is philosophical and creative orientation of the designer-craftperson. Courses are, therefore, based on theory or philosophical concepts in order to facilitate the development of visual sensitivity in relation to design. Major emphasis will be on the visual image as a personal interpretation of the media. Because the philosophical orientation of the student varies widely, progression from one level to another is based on the understanding and communication of visual concepts.

A representative course of study includes intensive training in the chosen areas of specialization such as 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.

PI BETA PHI ARROWMONT SCHOOL OF CRAFTS

Graduate students in the area of crafts have an unique opportunity to participate in the summer program at the Pi Beta Phi Arrowmont School of Crafts, Gatlinburg, Tennessee; credit is granted through The University of Tennessee, Knoxville.

Instructors at the school are nationally and internationally recognized designers and artisans who offer, in many instances, different approaches to those of the resident faculty; this further enriches the student's program of study. Craft courses are not offered in the Knoxville campus in the summer quarter. Therefore, students attending UT during the summer for crafts study are required to attend the Pi Beta Phi Arrowmont School of Crafts and pay the additional registration, tuition, and laboratory materials fees required by that school.

ACQUISITIONS AND EXHIBITIONS

For crafts and interior design majors, the department reserves the right of acquisition and exhibition of work completed in its studios under the guidance of the faculty. Prospective graduate students should submit a portfolio of their undergraduate studio work to the department. This portfolio may include slides or original work.

4110 Home Wiring and Lighting Requirements (3) Service of electricity in modern homes; evaluation of lighting and wiring plans in terms of family desires and need for equipment. 1 hr and 2 labs.

4130 Contemporary Design (3) Furnishings and interiors: economic, technological and sociological influences on the development of design; changing living conditions; interrelation of architecture and furnishings. Significant designers and their work.

4145 Exhibition Design (4) Display of craft and interior design students; in relation to materials, props and special exhibition areas. Emphasis on knowledge and application of the design principles and methods relating to promotion, design construction, display and evaluation for two and three dimensional displays. Annual student Craft and Interior Design exhibit culminates quarter. Prereq: 1410 or equivalent.

4155 Interior Space Planning I (6) Analysis, planning and design of office environment; includes contract specifications. Prereq: 3256 or equivalent.

4156 Interior Space Planning II (6) Studio problems involving large scale nonresidential interior spaces such as restaurants, transportation facilities, stores, institutions. Prereq: 4155 or consent of instructor.

4310 Crafts in America (3) Craft movement; factors that contributed to growth and development. Education, commercial and therapeutic values of crafts. Place of craftperson in society as producer, teacher, designer for industry.

4230 Housing Problems (3) Housing requirements of families. Reading and judging house plans; effective use of space; maintenance problems; housing regulations and restrictions; site selection and neighborhood development; financing procedures. Prereq: 6 hrs from Economics 2110-20-30.

4330 Care and Repair of Household Equipment (3) Care of equipment to give maximum service in relation to operation and service cost; understanding of common repair problems. Prereq: 2430. 1 hr and 2 labs.

4410 Craft Media (4) Possibilities and limitations of variety of craft media; understanding educational and social values of craft work. Designing and executing craft problems using inexpensive materials and tools. 3 labs.

4420 Leather Design (4) Relationship of design to function, techniques and materials. Creating leather objects of original design. Prereq: 1410 or equivalent. 1 hr and 2 labs.

4430 Plastics (4) Possibilities and limitations of various plastics; methods of fabrication; relation of design to function, processes, types of material and use of tools. Prereq: 1410 or equivalent. 1 hr and 2 labs.

5000 Thesis

5002 Non-Thesis Graduation Completion (3-15) 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. 3 credits only.

5040 Seminar in Design (3) Intensive reading, discussion and critical evaluation of twentieth-century design concepts, persons, motivation, and creative components leading to visual innovation.

5050 Advanced Design Studio (4) Strength, structural variability, and form potentials of design materials; search for aesthetic potential in depth.

5060 Practicum (1-12) Field experience in selected agencies and organizations that focus on solutions to problems in housing.

5120 Historic Interior Design (3) Research studies in social, economic, and philosophical aspects of interior design. The course content is the same as interior design, but it is offered to the graduate student. 1 hr and 2 labs.

5130 Contemporary Furnishings (3) Economic, technological and sociological influences on the development of design; changing living conditions; interrelation of architecture and furnishings. Significant designers and their work.

5210 Furniture Appreciation (3) Aesthetic qualities of past and present styles. Significant structural and formal characteristics.

5310 Interior Design (3) Advanced problems in planning and design of space and related construction; improvement of research information in making design decisions. Prereq: Consent of instructor.

5330 Craft Design (3) Fine design in international crafts, designing in basic craft media. 1 hr and 2 labs.

5341-51-61 Metal Design I, II, III (4, 4, 4) 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 design of two- and three-dimensional forms in metal design. 5352—Advanced experimentation using aesthetic concepts in design of two- and three-dimensional forms in weaving. 5353—Experimenting in unifying aesthetic concepts in preparation for graduate exhibition. Prereq: Previous work in metal design and consent of department head. Each course may be repeated one time.


5344-54-64 Wood Design I, II, III, IV (4, 4, 4, 4) Initial development of theory for investigation of aesthetic concepts in two- and three-dimensional forms in wood. 5354—Advanced experimentation using aesthetic concepts in preparation of two- and three-dimensional forms in wood design. 5364—Experimentation in unifying aesthetic concepts in preparation for graduate exhibition. Prereq: Previous work in wood design and consent of department head. Each course may be repeated one time.


5346-56-68 Plastics I, II, III, IV (4, 4, 4, 4) Initial development of theory for investigation of aesthetic concepts in two- and three-dimensional forms in plastic. 5356—Advanced experimentation using aesthetic concepts in preparation for 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, IV (4, 4, 4, 4) Initial development of theory for investigation of aesthetic concepts in two- and three-dimensional forms in ceramics. 5357—Advanced experimentation using aesthetic concepts in development of two- and three-dimensional forms in ceramics. 5367—Experimenting in unifying aesthetic concepts in preparation for graduate exhibition. Prereq: Previous work in ceramics and consent of...

5368 Ceramics—Glaze Calculation (4) Experimentation with various types of clay bodies and glazes for reduction and oxidation firing atmospheres. Prereq: Previous work in ceramics and consent of department head. May be repeated. Maximum 8 hrs.

5369 Ceramics—Kiln Construction (4) Designs for and construction of various sizes and types of kilns and burners 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 behavioral science, and 6 hrs natural science or consent of instructor.

5510 Environmental Factors in Interior Design (3) Human factors and associated research techniques related to design of interior architectural environments. Prereq: Consent of instructor. Preparations in psychology, anthropometry, and behavioral sciences. Prereq: 6 hrs behavioral science, and 6 hrs natural science or consent of instructor.

5520 Environmental Factors in Interior Design (3) Systematic design methodology as applied to design of microenvironments 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 analysis, synthesis, and evaluation of research-oriented interior design projects. Prereq: 3 hrs behavioral science, and 6 hrs natural science or consent of instructor.

5540 Environmental Design Analysis (3) Advanced methodology in psychology of environmental design, multidisciplinary research data and methods. Prereq: 5510-20-30.

6302 Role of Crafts in Society (3) Comprehensive individual study and group discussion of advanced concepts and current problems in crafts. Pre req: 4310, 5040, 6 hrs of graduate level sociology, or consent of instructor.

6410 Conceptual Development in Craft Design (3) Advanced concepts in use of visually perceived design elements as demonstrated in hand-crafted objects. Prereq: 5040, 6 hrs of graduate level psychology, or consent of instructor.

6420 Perspectives in Crafts and Interior Design (3) Historical influences related to contemporary concepts in crafts and interior design. Prereq: 5040, 6 hrs of graduate level art history, or consent of instructor.

Courses offered periodically only at the Pi Beta Phi Arrowmont School of Crafts, Gatlinburg, Tennessee. Courses may be repeated.

3111-21-31 Metal Design (1-4, 1-4, 1-4)
3121-21-31 Textile Design (1-4, 1-4, 1-4)
3131-21-31 Wood Design (1-4, 1-4, 1-4)
3171-21 Enameling (1-4, 1-4, 1-4)
4111 Crafts in America (1-4, 1-4) (Same as 4310.)
4141 Craft Media (1-4) (Same as 4410.)
4221 Leather Design (1-4, 1-4) (Same as 4420.)
4311 Plastics (1-4) (Same as 4430.)
4511-21-31 Ceramics (1-4, 1-4, 1-4, 1-4)
4621 Studio Problems in Leather Design (1-4)
4631 Studio Problems in Metal Design (1-4)
4641 Studio Problems in Weaving (1-4)
4651 Studio Problems in Textile Design (1-4)
4661 Studio Problems in Wood Design (1-4)
4671 Studio Problems in Enameling (1-4)
4681 Studio Problems in Plastics (1-4)
4691 Studio Problems in Ceramics (1-4)
5311 Craft Design (1-4) (Same as 5330.)
5411 Advanced Problems (1-4) (Same as 5410.)
5441-51-61 Metal Design (1-4, 1-4, 1-4) (Same as 5311-51-61-61.)
5442-52-62 Weaving (1-4, 1-4, 1-4, 1-4) (Same as 5342-52-62-62.)
5443-53-63 Textile Design (1-4, 1-4, 1-4, 1-4) (Same as 5343-53-63-63.)
5444-54-64 Wood Design (1-4, 1-4, 1-4) (Same as 5344-54-64.)
5445-55-65 Enameling (1-4, 1-4, 1-4) (Same as 5345-55-65.)
5446-56-66 Plastics (1-4, 1-4, 1-4) (Same as 5346-56-66.)
5447-57-67 Ceramics (1-4, 1-4, 1-4) (Same as 5347-57-67.)
5811-21-31 Problems in Related Art, Crafts and Interior Design (1-4, 1-4, 1-4) (Same as 5910-20-30.)
5911-21-31 Seminar in Related Art, Crafts and Interior Design (1-4, 1-4, 1-4) (Same as 5910-20-30.)

### Food Science, Nutrition, and Food Systems Administration

#### MAJORS

<table>
<thead>
<tr>
<th>Degree</th>
<th>MAJOR</th>
<th>FULL NAME</th>
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<tbody>
<tr>
<td>PhD</td>
<td>Food Science</td>
<td>J. D. Skinner, Ph.D. Oregon State.</td>
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<tr>
<td>PhD</td>
<td>Nutrition</td>
<td>F. E. Andrews, Ph.D. Ohio State; M. D. Brooks (Memphis), M.S. Alabama; G. W. Disney, Ph.D. Tennessee; R. L. Mason, M.S. Tennessee; J. D. Skinner, Ph.D. Oregon State.</td>
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<tr>
<td>PhD</td>
<td>Food Systems Administration</td>
<td>C. D. L. Pelton, Ph.D. Wisconsin; L. M. Odland, Ph.D. Wisconsin, D.Sc. Purdue; J. P. Savage, Ph.D. Wisconsin; J. T. Smith, Ph.D. Missouri; A. M. Smith (Memphis), Ph.D. Tennessee.</td>
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<tr>
<td>PhD</td>
<td>MAJOR</td>
<td>Associate Professor</td>
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<tr>
<td>PhD</td>
<td>Food Systems Administration</td>
<td>B. L. Black, Ph.D. Wisconsin; L. A. Ehrcke, Ph.D. Tennessee; D. W. Hubbard, Dr. P. H. Tulane; D. E. Lyon, M.S. Cornell; M. P. Penfield, Ph.D. Tennessee; M. N. Perry, Ph.D. Tennessee; M. N. Traylor, M.P.H. California (Berkeley).</td>
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#### DEGREES

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<td>M.S.</td>
<td>Nutrition</td>
<td>F. E. Andrews, Ph.D. Ohio State; M. D. Brooks (Memphis), M.S. Alabama; G. W. Disney, Ph.D. Tennessee; R. L. Mason, M.S. Tennessee; J. D. Skinner, Ph.D. Oregon State.</td>
</tr>
</tbody>
</table>

#### Food Science

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000</td>
<td>Origin of Food and Foodways</td>
<td>3 Food origin and development of individual and groups of foodways. Prereq: 8 hrs social science or humanities.</td>
</tr>
<tr>
<td>4010</td>
<td>Introductory Experimental Food Science</td>
<td>3 Physical and sensory evaluation in experimentation with fats, high protein foods, and bitter and dough systems. Prereq: 3510. 2 hrs and 1 lab.</td>
</tr>
<tr>
<td>4020</td>
<td>Experimental Food Science</td>
<td>3 Individual experimentation and its relation to the research literature. Prereq: 4010. Nutrition 3320 recommended. 1 hr and 2 labs.</td>
</tr>
<tr>
<td>4040</td>
<td>Food in Contemporary Society</td>
<td>3 Consumer's options, responsibility and potential influence with respect to food supply.</td>
</tr>
</tbody>
</table>

#### 5000 Thesis

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5000</td>
<td>Thesis</td>
<td>3 Thesis. Prereq: Previous work in food science and nutrition, or consent of instructor.</td>
</tr>
</tbody>
</table>

#### 5200 Non-Thesis Graduation Completion

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5200</td>
<td>Non-Thesis Graduation Completion</td>
<td>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. 5 NC only.</td>
</tr>
</tbody>
</table>

#### 5140 Foods and Nutrition: Physicochemical Principles

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5330</td>
<td>Food Systems Administration</td>
<td>3 Food science and chemical properties of proteins, carbohydrates and lipids; chemistry of colloid state; chemical kinetics; specialization of kinetics of enzymatic processes. Prereq: Nutrition 3330 and Mathematics 1450 or equivalent.</td>
</tr>
<tr>
<td>5440</td>
<td>Food Technology</td>
<td>3 Classification of foods according to textural parameters; instrumentation in evaluation of physical properties. Prereq: 4010 or Food Technology 4920; Plant and Soil Science 3610 or equivalent; or consent of instructor.</td>
</tr>
</tbody>
</table>
5320 Food Sensory Testing Methods (3) Principles and methodology of sensory evaluation of foods; application to individual problems. Prereq: 4010; Plant and Soil Science 3610 or equivalent; or consent of instructor.

5330 Community Nutrition (3) Nutrition programs of state and federal agencies; preparation of materials for nutrition teachers; extension methods; analysis of state agency data. Prereq: 4010; Plant and Soil Science 3610 or equivalent; or consent of instructor.

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

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

5410-20 Human Nutrition (3, 3) Functions of carbohydrates, proteins, fats, minerals and vitamins. Nutritional requirements of man through life span and practical problems in meeting requirements. Prereq: 3410 and 5110.

5430 Physiological Bases for Diets in Disease (3) Development in dietary treatment of disease in which nutrition plays a major role. Prereq: 5210 or equivalent.


5460 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.

5470 Nutrition and Aging (3) Nutritional problems of aging individual, nutritional requirements, dietary intakes, and effect of nutrition on rate of biological aging. Prereq: 5210 or consent of instructor.

5610 Nutrition in Mental Retardation and Developmental Disorders (1-12) Interdisciplinary diagnosis and treatment of developmentally handicapped child. Role of nutritionist; clinical experience and lectures at Child Development Center, Center for the Health Sciences, Memphis. Prereq: Consent of department head.

5700 Current Programs and Trends in Nutrition (1-3) Recent advances in food science, impact on curricular considerations, and implications for teachers, extension workers, and dietitians. Prereq: Consent of instructor. May be repeated.

5800 Problems in Food Science (1-3) Advanced study from field of food science. Prereq: Consent of department head and professor for their behavior in food. Prereq: 4010; Nutrition 3320-30 or equivalent.

5850 Field Experience (1-3) Experience in food-related industry or agency under supervision of 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

6310 Organic Chemistry (4) Emphasis on substructures and biological significance of carbohydrates, lipids, and proteins. Role of vitamins and minerals in metabolism. Not for graduate credit for nutrition science, nutrition and food science students. Prereq: 3339; Physiological Chemistry Laboratory (1) Prereq: 3320; Coreq: 3330, 1 lab. Not for graduate credit for nutrition majors.

6339 Physiological Chemistry Laboratory (1) Prereq: 3320; Coreq: 3330, 1 lab. Not for graduate credit for nutrition majors.

6420 Nutrition for Children, Adolescents and Adults (3) Application of basic principles and research findings to nutrition for children, adolescents and adults. Prereq: 8 hrs of nutrition. 2 hrs and 1 lab.

6430 Community Nutrition (3) Nutrition problems and services in the community; supervised field experiences are integral part of the course. Prereq: 6 hrs of nutrition.

6470 Introduction to Nutrition Research (3) Discussion of principles and laboratory experiments. Prereq: 6 hours of nutrition, 2 hrs and 1 lab.

6490 Seminar in Food Science (1-3) Prereq: Consent of department head and professor in charge of investigation. May be repeated.

6500 Seminar in Food Science (1-3) Current topics in food science. Lecture, discussion, and laboratory exercises. Prereq: 3320-30, 3410. 2 hrs and 1 lab.

6510 Advanced Physiological Chemistry (4) Bioenergetics and related metabolism of nutrients. Prereq: 3330 or equivalent. 3 hrs and 1 lab.

6520 Advanced Physiological Chemistry (3) Nutritional problems related to fluid and electrolytes, gas transport, and endocrine function. Prereq: 3330.

6540 Foods and Nutrition: Physicochemical Principles (3) Thermodynamics; physicochemical properties of proteins, carbohydrates and lipids; chemistry of colloidal state; chemical kinetics; specialized kinetics of enzymatic processes. Prereq: Nutrition 3330 and Mathematics 1540 or equivalent.

6570 Seminar in Food Science (1-3) Emphasis on methodologies and investigation of topics related to current problems in food science. Prereq: Consent of instructor. May be repeated.

6610 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.

6620 Food Dispersions (3) Physical characteristics of solutions, colloidal dispersions, and suspensions in relation to treatments applied. Prereq: 3610.

6620-20 Structure of Food Plants and Animal Tissues (3, 3) Historological structure of food plants and animal tissues related to physical characteristics and chemical properties of components. Prereq: 5630-40.

6650-20 Food and Sociocultural Change (3, 3) Critical evaluation of factors and interrelationships affecting food intake and consumption patterns. Must be taken in sequence. Prereq: 5520 or 5560; or consent of instructor.

6660 Seminar (1-3) May be repeated. S/NC only.

Nutrition

3310 Organic Chemistry (4) Emphasis on subjects leading to 3320-30. Textiles and Clothing 3320. Prereq: General Chemistry. 3 hrs and 1 lab. Not for graduate credit for nutrition majors.

3320 Food Analysis (4) Elementary quantitative analysis, titrimetry. Prereq: 3310 or equivalent. 3 hrs and 1 lab. Not for graduate credit for nutrition majors.

3330 Physiological Chemistry (3) Metabolism of carbohydrates, lipids, and proteins. Role of vitamins and minerals in metabolism. Not for graduate credit for nutrition science, nutrition and food science students. Prereq: 3339; Physiological Chemistry Laboratory (1) Prereq: 3320; Coreq: 3330, 1 lab. Not for graduate credit for nutrition majors.

3390 Physiological Chemistry Laboratory (1) Prereq: 3320; Coreq: 3330, 1 lab. Not for graduate credit for nutrition majors.

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 nutrition for children, adolescents and adults. Prereq: 8 hrs of nutrition. 2 hrs and 1 lab.

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

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

4230 Nutrition in Disease (4) Nutrition problems in diseases influenced by diet. Prereq: 3410. 2 hrs and 1 lab.

4231 Clinical Experience in Diabetics (1) Planned clinical experience concentrating on understanding 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 effects of drugs and the dietary or behavior modifications required. Prereq: 4230. Designed 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: 3410 or consent of instructor.

5000 Thesis

5002 Non-Thesis Graduation Completion (3-15) 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 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 affecting body fluids, gas transport, and endocrine function. Prereq: 3330.

5140 Foods and Nutrition: Physicochemical Principles (3) Thermodynamics; physicochemical properties of proteins, carbohydrates and lipids; chemistry of colloidal state; chemical kinetics; specialized kinetics of enzymatic processes. Prereq: Nutrition 3330 and Mathematics 1540 or equivalent.


5240 Research Techniques (3, 3) Analytical methods to assay of food and biological materials. Human metabolic balance experiments. Prereq: 5230. 3 labs.

5310 Community Nutrition (3) Nutrition problems and services in community; supervised field work. Prereq: 3410 and 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 materials for nutrition teachers; extension methods; analysis of state agency data. Prereq: 4010; Plant and Soil Science 3610 or equivalent; or consent of instructor.
Food Systems Administration
4130 Food Systems Administration (3) Functions of management applied to food service systems. Prereq: 3110.
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) Design of physical facilities and selection and purchasing of equipment for food service systems. Prereq: 3110 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: 4150, Accounting 2130.
4260 Food and Lodging Physical Plant, Planning and Maintenance (4) Feasibility, planning development and construction of food and lodging physical plant and maintenance. Electrical, mechanical, heating, plumbing, air conditioning and ventilation and illumination systems. Types of building materials and construction. Prereq: 3110, 4150 or consent of instructor. 3 hrs and 1 lab.
4270 Food and Lodging Information Systems (3) Qualitative and quantitative analysis of information systems for decision making in food and lodging systems. Prereq: 4130, 4250, Office Administration 2750.
5000 Thesis
5002 Non-Thesis Graduation Completion (3-15) 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. Management resources. Prereq: 4130, 3110, 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) Environment in which food is prepared; design of school food service and college dining facilities. Prereq: 4150.
5230 Food Systems Evaluation (3) Management resources in food systems. Standards for control. Prereq: 4130, or consent of instructor.
5310 Administration of Food Service Delivery Systems (3) Role and responsibilities of administration in maintaining desired qualitative and quantitative standards in food service delivery system. Prereq: 3110 or consent of instructor.
5500 Clinical Training in Health Care Agencies (3) Instructional and supervisory techniques in clinical settings by nurses and dietitians for training of entry-level health care providers. Prereq: Nursing 4760 or 4140 or consent of instructor.
5700 Current Programs and Trends in Food Systems Administration (1-3) Recent advances in food systems administration and implications for dietetic, food science, 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.
5860 Field Experience (3-9) Planned administrative experience in food service system. Prereq: Consent of instructor.
5900 Seminar in Food Systems Administration (1-3) May be repeated.
6110 Advanced Topics in Food Systems Administration (3) Comprehensive individual study and group discussion of 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; problems 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 efficiency and effectiveness in food service systems. Prereq: 5260 or consent of instructor. Taken in sequence. Credit for 5310 contingent upon completion of 6320.
6900 Seminar (1-3) May be repeated. S/NC only.

**Home Economics**

**MAJOR**

**DEGREE**

**Ph.D.**

**Professors:**

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

**Assistant Professor:**

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

**5600 Practicum (1-12) Field experience in selected organizations that focus on interdisciplinary solutions to multilevel problems of society. Prereq: Consent of instructor. May be repeated. Maximum 12 hrs.**

**5100 International Studies (1-15) Student- or staff-initiated course for study in foreign country of topic(s) pertinent to field. Topic to be determined by student and instructor with department 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 programs; emphasis on projection of future developments.**

**5220 Development of Community Service Programs (3).**

**5230 Evaluation of Community Service Programs (3) Purposes of evaluation, clarification of objectives and procedures for determining progress.**

**5600 Home Economics in the Community (3) Role of home economists in community and how interactions among professionals of all community resources facilitate finding solutions for and/or solving problems of individuals, families, and communities related to quality of life. Prereq: Agricultural Economics 4320 or Economics 5540 or Planning 4110 or Child and Family Studies 5700 or consent of instructor.**

**5700 Current Programs and Trends in Human Resource Development (1-3) Current developments in area related to human resources and impact on society through community service programs and other programs in education, business, and government. Prereq: Consent of instructor. May be repeated. Maximum 9 hrs.**

**5800 Problems in Community Services (1-3) Prereq: Consent of professor in charge of investigation. Hrs and credit to be arranged. May be repeated. Maximum 9 hrs.**

**5900 Seminar in Human Resource Development (1-3) May be repeated. S/NC only.**

**6000 Doctoral Research and Dissertation (1-3) May be repeated.**

**Textiles and Clothing**

**MAJORS**

**TECHNOLOGY AND CLOTHING**

**DEGREES**

**M.S.**

**Home Economics**

**Ph.D.**

**Professor:**

A. J. Treece (Head), Ph.D. Ohio State.

**Associate Professors:**

L. A. Ford, Ph.D. Pennsylvania State; B. C. Goswami, Ph.D. Manchester (England); C. J. Noel, Ph.D. Notre Dame.

**Faculty Associate:**

T. L. Vigo, Ph.D. Tulane.

**Assistant Professors:**

C. E. Cox, Ph.D. Tennessee; R. P. Dowlen, M.S. Tennessee; M. F. Drake, Ph.D. Pennsylvania State; L. A. Kocher, Ph.D. California (Davis).

**4210 Elementary Textile Microscopy (3) Microscopic techniques as applied to the study of textile fibers and fabrics. Prereq: 4010. 1 hr and labs.**

**4240 Design Analysis II (3) Interpretation of design determining in finished garments developed through the media of draping.**

**5000 Thesis**

**6002 Non-Thesis Graduation Completion (3-15) 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 Research in Textiles (3) Physical and chemical testing. Research methods. 3 labs.**

**5120 Advanced Problems in Textiles and Clothing (3) Refresher course; new developments in textiles. Selecting fabrics, agencies aiding consumer; and individual problems in textile field. 2 hrs and 1 lab.**

**5130 Advanced Tailoring (3) Comparison of hand tailoring and trade methods used in making suits, coats, or costumes. 3 labs.**

**5150 Principles of Design Analysis (3) Application of optical 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.**
Aviation Systems

MAJOR
Aviation Systems

DEGREE
M.S.

Lead Professor: M. A. Wright, Ph.D. Wales.

Professors: W. Frost, Ph.D. Washington; W. F. Jacobs, Ph.D. Goettingen (Germany); A. A. Mason, Ph.D. Tennessee; J. M. Wu, Ph.D. California Institute of Technology; R. L. Young, Ph.D. Northwestern.

Associate Professors: F. G. Collins, Ph.D. California (Berkeley); R. D. Kimberlin, M.S. Tennessee; J. R. Maus, Ph.D. North Carolina State.

Assistant Professors: W. B. Baker, Jr., Ph.D. Tennessee; W. J. Boaz, M.S. Florida State; V. K. Smith, Ill, Ph.D. Georgia Institute of Technology.

The University of Tennessee Space Institute offers a 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, 6 or more quarter hours credit in each of the areas of research, development and administration, and electives which permit further specialization to 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 the 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 Aerospace Engineering 4110 and 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 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, 6 quarter hours in Industrial Engineering 5700 and 5710 and for the administration area, 6 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 Aviation Systems 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, 9 quarter hours in Industrial Engineering 5700, 5710, and 5720 and for the administration area, 9 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 3 quarter hours in Aviation Systems 5100, Project in Aviation Systems.

Courses suitable for credit in the major field include: Aerospace Engineering 5810, Aviation Systems—An Overview; Aerospace Engineering 5820, Air Vehicles; Industrial Engineering 5840, Air Traffic Control Systems; Aviation Systems 5070, Airports and The Community; 5080, Collection and Distribution; 5090, Government Policies for Aviation; 5210, Experimental Flight Mechanics, Performance; 5220, Experimental Flight Mechanics, Stability and Control; 5970, Special Topics in Aviation Systems.

Electives typical of those suitable for credit in the area of aviation systems, research and development include: Aerospace Engineering 5150-60-70; Computer Science 3510-20, 4550 and 5655-65-75; Industrial Engineering 4080, 4150, 4230, 5720, 5730, 6700, 6730; Mathematics 4220-30, 4510-20-30; Metallurgical Engineering 5810-20-30; and Statistics 3550.

Electives typical of those suitable for credit in the area of aviation systems, administration include: Accounting 5820; Business Law 5110; Economics 5080; Finance 5100; Industrial Management 5130; Marketing 5100; Transportation 5100, 5130, 5210-20, and 5910.

5000 Thesis
5070 Airports and the Community (3) Structure of airports and their communities. Technology and economics of cargo, baggage, ticket and passenger handling, Airport management, economics and logistics. Interfaces with the community, collection and distribution, demand requirement analyses, types of developments and their projections. Prereq: Aerospace Engineering 5810.
Inquiries concerning the admission requirements should be addressed to the Director, Graduate Program in Ecology, 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. The chairman of the student’s faculty Committee will become the chairman of the student’s faculty committee.

THE MASTER’S PROGRAM
The minimum 45 quarter hours of graduate credit shall include 18 hours of ecology courses (exclusive of thesis), of which 6 hours shall be in Ecology 5210-20-30 and at least 8 additional hours in ecology courses numbered above 5100; 9 hours of thesis in Ecology 5000, and 18 additional hours in ecology or supporting courses. To insure an interdisciplinary program, the required minimum 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 19.

A minor in ecology shall include Ecology 5210-20-30 (6 hours) and at least 3 additional hours in approved ecology courses.

THE DOCTORAL PROGRAM
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 at least 9 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 Facility

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
1010 Biology of Soil Microorganisms (4)
Agricultural Economics and Rural Sociology
4330 Land Economics (3)
5420 Advanced Land Economics (3-9)
5380 Field Work in Physical Anthropology (3-9)
5460 Zoarcheology (3)
5896 Primate Paleontology (3)
4970 Human Paleontology (3)
5970 Emergence and Early Evolution of Man (3)
Botany
4310 Plant Ecology (4)
5340 Plant Geography (4)
5350 Analysis of Plant Communities (4)
5150-20-30 Systems Ecology (3, 3)
5530 Field Methods in Plant Ecology (4)
6320 Ecosystems of the World (3)
Ecology
5000 Thesis
5100 Special Problems in Ecology (1-3) Individual Investigations in Ecology. May be repeated with consent of instructor. Maximum 3 hrs.
5210-20-30 Principles of Ecology (2, 2, 2)
5530 Principles of Ecology (2, 2, 2) Theories and problems in ecology. Comparisons between land, freshwater, and marine environments, including humanity’s role in the world’s ecosystems. Must be taken in sequence. Prereq: 4 hrs of ecology at the upper division level.
5310 Ecology for Planners and Engineers (3) Ecological principles and effects that human activities have caused changes have on living organisms. Lectures and field trips. F. Schmitt, Ph.D. In Graduate School of Planning and Environmental Engineering.
5320 Implementation of Environmental Policy (3) Goals and problems of environmental legislation, especially National Environmental Policy Act; purpose, preparation, and evaluation of environmental legislation; statements and similar multidisciplinary studies. Prereq: 5210 or 5310, or Environment Engineering 4820.
5330 Marine Ecology (4) Relationships of marine organisms to environment and their interactions.
with each other. Trophic relationships in neritic, coastal, and estuarine ecosystems; succession; deep-sea ecology; stability. Prereq: One previous ecology course.

5610 Environmental Toxicology (3) (Same as Biochemistry 5610.)

5640 Techniques in Environmental Toxicology (2) (Same as Biochemistry 5640)

6000 Doctoral Research and Dissertation

6100 Special Topics in Ecology (3) Seminars on advanced topics and recent developments in ecology. Prereq: Consent of instructor. May be repeated.

6110 Seminar in Animal Behavior (2)

6120 Seminar in Aquatic Ecology (2)

6130 Seminar in Physiological Ecology (2)

6140 Seminar in Community Ecology (2)

6150 Seminar in Radiation Ecology (2)

6160 Seminar in Systems Ecology (2)

Economics

4260 Economics of Resources and Environmental Policies (3)

Environmental Engineering

4530 Sanitary Engineering Laboratory (3)

4600 Solid Waste Management (3)

4700 Air Pollution-Air Resources Management (3)

5593 Advanced Sanitary Engineering Laboratory (3)

5700 Planning and Air Pollution Control (3)

5710 Air Pollution Control Engineering (3)

Forestry, Wildlife, and Fisheries

4450 Game Mammals (4)

4460 Game Birds (4)

5210 Seminar in Wildlife Conservation (3)

5220 Seminar in Forest Tree Biology (3)

5240 Seminar in Forest Genetics (3)

5460 Predator Ecology (3)

Geography

4720 Data Mapping (4)

4740 Remote Sensing: Types and Applications (4)

5550 Topics in Geography of Land-Surface System (3)

5610 Topics in Climatology (3)

5740 Advanced Topics in Remote Sensing (3)

Geology

4230 Paleocology (4)

4240 Paleobotany (4)

4510 Principles of Geomorphology (4)

5290 Quaternary Problems (4)

5915 Regional Geomorphology (4)

Microbiology

5829 Experimental Microbial Ecology (3)

Nuclear Engineering

5210 System Dynamics (3)

Philosophy

4710 Philosophy of Natural Science (4)

5550-60 Philosophy of Science (4, 4)

6550 Seminar in Philosophy of Science (4)

Plant and Soil Science

4320 Soil Formation, Morphology and Classification (4)

5240 Soil Productivity and Management (3)

5250 Pedology (4)

5810 Crop Climatology (4)

5820 Advanced Crop Physiology and Ecology (4)

Psychology

4900 Aspects of Urban Environment (4) S/JNC only.

5750 Ethological Psychology (3)

Sociology

4110 Population Problems (4)

4330 Urban Ecology (4)

6180 Theory and Method of Human Ecology (3)

Zoology

4200 Ichthyology (5)

4240 Animal Ecology (4)

4660-70 Limnology (4, 4)

4700 Arachnology (4)

5570 Animal Populations (3)

5860 Geographic Distribution of Animals (4)

Industrial and Organizational Psychology

MAJOR DEGREES
Organizational Psychology M.S., Ph.D.

Committee: M. E. Gordon (Chairperson); W. H. Calhoun; F. A. Chamberlain; H. D. Dewar; J. M. Larsen, Jr.; M. Lounsberry; J. W. Philpot; M. C. Rush; E. D. Sundstrom; G. H. Whitlock.

(For complete Faculty Listing, see Departments of Management and Psychology)

The Master's and doctoral programs are offered jointly by the Department of Psychology and the Department of Management. They are designed to prepare students for personnel, managerial, and organizational research, for university teaching, and for consulting relationships with industry. The emphasis is upon applied research utilizing a thorough theoretical background, including classical and modern organization theory, organizational behavior, psychology, and 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 opportunities to take courses which will assist the student to attain a reasonable level of sophistication in areas of deficiency (Psychology 5350-60).

ADMISSION PROCEDURE

Applicants for admission should request forms and materials from both the Graduate Office and the Chairperson, Industrial and Organizational Psychology Program, 419 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 assistance consideration. Standards: At least 9 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 on the Graduate Management Admission Test or on each section of the aptitude portion of the GRE must be reported. Customarily, those students admitted to the Program have performed at or above the 63rd to 65th percentile on each of these tests. (This corresponds to a raw score of approximately 500 on each of the tests.) The advanced section for psychology (GRE 81) is required of all applicants regardless of whether their scholastic aptitude is assessed with the GRE or GMAT.

THE MASTER'S PROGRAM

I. Course Requirements

A. Management or Psychology 5170, 5180, 5190 (Proseminar in Industrial and Organizational Psychology).

B. Statistics 5050-60-70 (Behavioral Statistics) and 3 hours of applied psychometrics.

C. Eighteen hours of additional course work to be selected primarily from among the 5000-level course offerings in management and psychology (e.g., Management 5110, 5120, 5230; Psychology 5080 (Current Topics in Applied Psychology)).

D. Nine hours of Psychology or Management 5000 (Master's Thesis).

E. Recommended: Psychology Proseminar.

II. Program Requirements

The Ph.D. program requirements described below in sections II A, II B, and II G comprise the major requirements for a Master's degree. An oral examination covering the thesis and related topics must also be completed.

THE DOCTORAL PROGRAM

I. Course Requirements

A. Minimum course requirements:

  1. Management or Psychology 5170,
and Organizational Psychology Committee. This required review of the student's record suggests that additional required to prepare a Master's thesis by the Industrial
experimental design.
attaining a score of 650 on the GRE
Organizational Psychology (Management
Administration: Management 5220 (Wage
Psychology), Management or Psychology
5180, 5190 (Proseminar in Industrial and
98 Intercollegiate Programs
5. Courses available in areas related to
industrial and organizational psychology:
a. Through College of Business
Administration: Management 5220 (Wage
and management science), Management
5240 (Seminar in Personnel Research),
Labor Economics;
b. Through College of Liberal Arts:
Psychology 5450, 5460, 5470, Industrial
Sociology.
II. Program Requirements*:
A. Attainment of a B average in the
Proseminar in Industrial and
Organizational Psychology (Management
or Psychology 5170, 5180, 5190).
B. Completion of a comprehensive
examination in general psychology within
no more than two years of entry by
attaining a score of 650 on the GRE
Advanced Test in Psychology.
C. Completion of a general preliminary
examination in scientific methodology
before beginning the third year of study.
This examination covers the following
specific areas: statistics, psychometrics,
experimental design.
D. Completion of a special preliminary
examination in the area of the student's
major research and professional interest.
A student is expected to take this
examination by the end of twelve
quarters. This examination may be
repeated once, normally no later than six
months after the first attempt, at the
discretion of the student's doctoral
committee.
E. By the end of nine quarters a
student is expected to choose a major
advisor (Chairperson of Doctoral
Committee).
F. Completion of an oral examination
following the preparation of a doctoral
dissertation. This examination covers the
field of the doctoral research and related
topics, and is passed at least four
weeks prior to the awarding of the degree.
G. Maintenance of at least 3.0 grade
point average.

Management Science
MAJOR: Management Science
DEGREE: M.S.
Committee:
C. E. Bell (Chairperson), Management Science;
R. W. Boiling, Management; J. S. Bradley,
Mathematics; R. L. Church, Civil Engineering;
R. S. Garfinkel, Management Science;
E. Glustoff, Economics; R. E. Rosenthal,
management science; S. Selkow, Computer
Science; R. E. Shirevax, Finance; C. C. Thigpen,
Statistics.
THE MASTER'S PROGRAM
The M.S. program in Management Science is designed as preparation for a
career in the application of quantitative techniques for the solution of
management problems in large organizations. The program's flexibility also
makes it appropriate as preparation for doctoral study in Management
Science.
Management Science course work will expose students to both the theoretical
development of quantitative techniques and their application to managerial
decision making. In addition to the development of sufficient mathematical
maturity for creative use of quantitative skills, the program allows concentrated
study in an area of application within the
College of Business Administration. With
the wide-spread application of
management science, the student
may (with the approval of the
Management Science Committee) choose
an applied concentration in a field outside the
College of Business Administration.
Applications are encouraged from all
majors, but mathematical background equivalent to the completion of at least
two years of college calculus and proficiency in a computer language (e.g.,
Computer Science 3150) is required. The
program is designed to be completed in one
calendar year of full-time, but applications are also encouraged from
prospective part-time students.
Course Requirements

<table>
<thead>
<tr>
<th>Course Requirements</th>
<th>Quarter Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Science 5310-20-30-35-40</td>
<td>14</td>
</tr>
<tr>
<td>Applied concentration area (approved by advisor)</td>
<td>12</td>
</tr>
<tr>
<td>Statistics 5110</td>
<td>3</td>
</tr>
<tr>
<td>Statistics elective (5000 level or above)</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics (4000 level or above)</td>
<td>6</td>
</tr>
<tr>
<td>Electives selected from mathematics, statistics, computer science, and/or management science</td>
<td>6</td>
</tr>
<tr>
<td>Electives in any area approved by advisor</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
</tr>
</tbody>
</table>

A thesis option is available which substitutes 9 hours of thesis credit for
the following 14 hours of course work:
Management Science 5335-40, and one
3-hour course in the applied concentration
area and 6 hours of electives in any area.
The Management Science Committee will
work closely with the student in tailoring a
program to his/her needs. The committee
must approve a tentative overall program
during the student's first quarter and
must approve all courses on a
quarter-by-quarter basis.
Recognizing the diverse backgrounds and
needs of Management Science M.S. students, the Management Science
Committee is prepared to waive some of
the above requirements on an individual
basis. For example, an undergraduate
major with sufficient background may be
allowed to take 6 additional hours of electives in place of
the mathematics requirement. On the
other hand, a student lacking experience
in rigorous senior-level mathematics
courses will be asked to take such
courses to fulfill the 6-hour mathematics
requirement. The total course load will
remain 50 hours for all non-thesis
students and 54 hours for all thesis
students; however, the number of hours of electives can be reasonably expected
to vary between 6 and 18 as a function of prior background.

Prerequisites for Management Science Courses
The Management Science Program is interdisciplinary and students in other degree programs are encouraged to enroll in management science courses. Course prerequisites are designed to indicate the level at which courses are taught. Interested students whose prior course work does not match the
prerequisites are encouraged to seek the
instructor's guidance and consent to
enroll.
For course listings and description of
the Ph.D. program in Management
Science, refer to the Department of
Management Science, College of
Business Administration.

Water Resources Development
MAJOR: Water Resources Development
DEGREE: M.S.
William F. Brandes, Director, Water Resources Research Center
Specific requirements for admission to this program are a Bachelor's degree in
law, engineering, or one of the physical or
social sciences from an accredited college or
university, and evidence of ability to do
work of graduate quality, as ascertained by
undergraduate records. Also required is
consideration of applicant's record, if any, and
letters of recommendation. The general
policies and requirements of the Graduate School apply to this program.
The degree of Master of Science requires 45 quarter hours of graduate
studies, including 9 hours of thesis work.
The exact curriculum of each student is decided in consultation with a faculty
committee, depending upon background and field of interest. If during the
undergraduate work the student has, in
the opinion of the faculty committee,
sufficient training and education in one or
more of the required courses, the student may substitute other elective courses. Electives will consist of advanced work in the student's speciality or in a related field.

3410 Principles of Ground Water Geology (3) (Same as Geology 3410.)
3565 Introduction to Public Administrative Organization and Management (4) (Same as Political Science 3565.)
4110 Managerial Economics (3) (Same as Economics 4110.)
4810 Water Law (3) (Same as Environmental Engineering 4810.)
5000 Thesis
5130 Planning Research Methods I (2) (Same as Planning 5130.)
5160 Planning and Utilities (3) (Same as Environmental Engineering 5160 and Planning 5160.)
5340 Hydrology of Agricultural and Forest Lands (3) (Same as Agricultural Engineering 5340.)

5410-20-30 Interdisciplinary Seminars (3, 3, 3)
Problems relating to comprehensive water resource development; flood management, hydroelectric power, navigation, recreation, alternatives in water resource planning, tomorrow in today's planning, project formulation and justification, direct and indirect economic consequences, state and local participation, and municipal and industrial uses of water developments.
INDEPENDENT STUDY
Certain educational goals may best be met through independent study done by an individual under the direction of a faculty member. Students who wish to do such independent work should obtain the approval of the faculty members and the departments concerned prior to embarking upon their study. Credit per quarter will vary from 1-12 hours. The maximum credit which may be applied toward a degree in the College is established in each individual case by the department in which the student is working.

DEPARTMENTS OF INSTRUCTION

FOREIGN STUDY COURSES
Foreign study courses offered in some departments of the College provide an opportunity to undertake independent study outside the United States. Prior to departure the student must have a plan of study approved by the department head and a supervising faculty member of the department concerned. Credit will be given only upon fulfilling all requirements set by the department and may vary from 1-12 hours. The maximum credit which may be applied toward a degree in the College is established in each individual case by the department in which the student is working.

OFF-CAMPUS STUDY
Recognizing that learning is not restricted to formal classroom situations, the College provides for students to earn credit toward graduation for approved off-campus study. Such study may be undertaken only with prior approval of the faculty member and the department concerned. It may include certain kinds of work experiences, community involvement, working in political campaigns, etc. Credit per quarter will vary from 1-12 hours. The maximum credit which may be applied toward a degree in the College is established in each individual case by the department in which the student is working.

THE MASTER'S PROGRAM
The formal requirements for the Master's degree include:
1. A minimum of three quarters of residence at The University of Tennessee, Knoxville.
2. A minimum of 45 quarter hours for graduate credit, including preparation of thesis. Thirty-six of these 45 hours must be in anthropology. Nine hours may be taken in closely related disciplines (at least one-half of the courses must be at the 5000 level).
4. A thesis. In addition to the two (2) copies required by the Graduate School, one bound copy of the thesis is to be presented to the department and one bound copy to the student's thesis advisor.

THE DOCTORAL PROGRAM
Although there is no minimum credit hour requirement for the Ph.D. degree, students in this program should plan to devote to its attainment no less than 3 years beyond the B.A. level and to complete the following requirements:
1. Admission to Ph.D. program through passing the Graduate Evaluation Examination at completion of first year of study, or through departmental acceptance of a previously earned M.A. degree in Anthropology.
2. Formation of an advisory committee and establishment in consultation with that committee of a program of study, Delineation of field(s) of competence by the student and committee and subsequent presentation to graduate advisor.
3. Demonstration of competence in a foreign language as determined by the student's committee.
4. Successful completion of oral and written comprehensive examinations and admission to candidacy.
5. Successful completion of the dissertation and final oral examination.