The College of Business Administration and the College of Engineering offer an integrated program leading to the conferral of the Master of Business Administration degree with a major in business administration (concentration in operations management) and the Master of Science degree in one of the following engineering majors: aerospace, biomedical, chemical, computer, electrical, engineering science, industrial, materials science, mechanical, and nuclear engineering (refer to each major for specific information and requirements).

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

ADMISSION

Applications are accepted for fall semester only. Applicants for the MS-MBA program must make separate application to, and be competitively and independently accepted by, the Office of Graduate and International Admissions for the Master of Business Administration degree program and the office of Associate Dean for Student Affairs at the College of Engineering.
Students will initially apply for the MBA program, indicating on their application the intent to pursue the dual MS-MBA program and the appropriate engineering major (refer to the MBA program for separate instructions). Students accepted for both the MBA and the MS with a major in one of the participating engineering majors will be assigned to Dual Program Committee advisors, who will be responsible for course approval and supervision of the students’ progress through the dual program.

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

REQUIREMENTS

All engineering students enrolled in the program must complete common coursework designed to provide them with an integrated, multidisciplinary teamwork experience. The MBA curriculum in product development and manufacturing consists of 30 hours of common coursework in the College of Business Administration and 12 hours of common coursework in the College of Engineering. Engineering common coursework includes a culminating three-hour integrated project course requiring a comprehensive report, and a final examination as required by the Dual Program Committee, to be taken during the first session of summer following the second year.

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

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

Approval Dual Credit

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

College Requirements for the Doctor of Philosophy Degree

Detailed minimum university requirements for the various doctoral degrees are listed on pages 34-36 of this catalog. Most departments have additional specific requirements listed in their portion of the catalog listings. The college of Engineering has the following specific requirements that must be met for all doctoral degree programs in the college.

- A minimum of 72 hours of graduate credit (coursework plus research and dissertation)
- A minimum of 24 hours Doctoral Research and Dissertation
- A minimum of 36 hours of graduate coursework hours. Departments, programs and/or dissertation committees may impose a higher minimum.

Graduate Program at the UT Space Institute

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

Department of CHEMICAL ENGINEERING

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

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

Professors
Bienkowski, P.R., PhD .................................................Purdue
Collier, J.R., PhD ......................................................Case Institute of Technology
Counce, R.M., PhD .......................................................Tennessee
Moore, C.E. (Distinguished Service Professor), PhD, PE ..........Louisiana State
Sheth, Anil C. (UTSI), PhD ........................................Northwestern

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

Adjunct Faculty
Arnold, J.S., PhD ........................................................Tennessee
Steele, W.V., PhD .........................................................Queens (Belfast)

Emeriti Faculty
Holmes, J.M., PhD .......................................................Tennessee
Prados, J.W., PhD, PE ................................................Tennessee

MAJOR DEGREES

Chemical Engineering .........................................................MS, PhD

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

CORE GRADUATE CLASSES IN CHEMICAL ENGINEERING

A graduate degree in chemical engineering requires the mastery of the core fundamentals of the discipline. These fundamentals are represented by five core courses: 505, 531, 547, 548, and 551. Both the master’s (thesis and non-thesis) and doctoral degrees in chemical engineering require the successful completion of these core courses.

ADDITIONAL COURSEWORK

In addition to the core classes, supplementary coursework appropriate for each graduate degree will be needed. The coursework beyond the core courses is determined in consultation with the student’s advisor and dissertation or thesis
committee and must be approved by the committee and the department head.

**MASTER OF SCIENCE**  
**Chemical Engineering Major**

**REQUIREMENTS**

**Thesis Option**

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

- A total of at least 21 semester hours in graduate level courses (excluding 500 and 501) in chemical engineering and related areas beyond the baccalaureate. These courses must include the five core courses (see above).
- Research and a thesis to give at least 9 hours of credit in 500.
- Active participation in graduate seminars in the department. Resident students must register for 501 every semester it is offered.
- A final oral examination covering the thesis and related fields and graduate coursework.

**Non-Thesis Option**

Under certain conditions, a candidate may apply for a non-thesis program. To be eligible, a candidate must show evidence of significant professional experience after the baccalaureate degree; at least five years of industrial experience or research publications would be examples of such evidence. The departmental faculty will consider each application individually. Upon acceptance, the requirements for completion of the non-thesis option are as follows:

- A total of at least 33 hours in graduate courses in chemical engineering and related areas beyond the baccalaureate. These courses must include the 5 core courses (see above).
- Completion of a critical review of the literature and other sources in an area related to chemical engineering (Chemical Engineering 580).
- A written comprehensive examination over the major field and an oral examination covering the review paper and related areas.

**DOCTOR OF PHILOSOPHY**  
**Chemical Engineering Major**

**REQUIREMENTS**

Students may apply directly to the PhD program either with or without having completed a master’s thesis. Students proceeding directly to the PhD program from a baccalaureate degree should submit evidence of outstanding performance in a rigorous undergraduate program and the ability to perform independent research at the doctoral level.

A total of 72 credit hours beyond the bachelor’s degree are required for the PhD degree. These consist of coursework hours and research and dissertation credit hours (Chemical Engineering 600). Specifically, the department requirements consist of the satisfactory completion of

- A minimum of 36 semester hours in graduate level courses (excluding 600) in chemical engineering and related fields beyond the baccalaureate. These courses must include the five core courses (see above) and at least 6 hours of courses at the 600 level from the University of Tennessee, Knoxville.
- The comprehensive examination, consisting of a written part and an oral part. The written part covers the core fundamentals of the program. The defense of the dissertation proposal constitutes the oral portion of the exam.
- A minimum of 24 credit hours of research and dissertation credit in Chemical Engineering 600. Registration must be continuous from the time research begins (see the Continuous Registration requirement in the Graduate Program Requirements).
- Successful oral defense of the dissertation before the student’s dissertation committee.
- Active participation in graduate seminars before the student’s dissertation committee.

**Curriculum For Dual MS-MBA Chemical Engineering Major**

**August—First Year**

Business Administration 511 MBA Core I ........................................ 3

**Fall—First Year**

Business Administration 512 MBA Core II ....................................... 15
Mechanical Engineering 504 ......................................................... 1

**Spring**

Business Administration 513 MBA Core III ................................. 9
Mechanical Engineering 506 ......................................................... 2
Mechanical Engineering 508 ......................................................... 3

**Summer**

—Internship ................................................................. —
Chemical Engineering 509 ......................................................... 1

**Fall—Second Year**

Chemical Engineering 509 ......................................................... 1
—Departmental/Engineering Courses* ........................................ 9

**Spring**

—MBA Hub Course Elective ..................................................... 3
Chemical Engineering 509 ......................................................... 1
—Departmental/Engineering Courses* ........................................ 9

**Summer (first session)**

Chemical Engineering 594 ......................................................... 3

Total 60

*The departmental courses include the five required departmental core courses.

**Graduate Certificate in Maintenance and Reliability Engineering**

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

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

Department of
CIVIL AND ENVIRONMENTAL
ENGINEERING

http://www.engr.utk.edu/civil/

Gregory D. Reed, Head
Richard M. Bennett, Graduate Liaison

Professors
Bennett, R.M., PhD, PE .................................................Illinois
Burdette, E.G. (Fred N. Peebles Professor), PhD, PE ..............Illinois
Chatterjee, A., PhD, PE ....................................................North Carolina State
Davis, W.T. (Associate Dean), PhD ........................................Tennessee
Deatherage, J.H., PhD, PE ...............................................Tennessee
Drumm, E.C. (Research Fellow), PhD, PE .........................Arizona
Penamadu, D. (Research Fellow), PhD ...................................Georgia Tech
Reed, G.D., PhD, PE .......................................................Arkansas
Robinson, R.B. (Fishier Professor), PhD, PE ....................Iowa State
Urbanik, T. (Goodrich Chair), PhD, PE .........................Texas A&M
Wegmann, J., PhD .......................................................Northwestern

Associate Professors
Cox, C.D., PhD, PE ......................................................Penn State
Han, L.D., PhD ..........................................................California (Berkeley)
Miller, T.L., PhD, PE ........................................................Tennessee
Richards, S.H., PhD, PE ...............................................Tennessee
Robinson, K.G., PhD .......................................................Virginia Tech

Assistant Professors
Chu, K.H., PhD, PE ..........................................................California (Berkeley)
Gentry, R., PhD, PE ......................................................Memphis
Huang, B. (Research Fellow), PhD, PE .........................Louisiana State
Schwartz, J., PhD, PE .....................................................Illinois

Emeriti Faculty
Goodpasture, D.W., PhD, PE ...............................................Illinois
Tschantz, B.A., ScD, PE ...............................................New Mexico State

MAJORS DEGREES

Civil Engineering ..............................................MS, PhD
Environmental Engineering ............................MS

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

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

Master of Science

The Master of Science programs in civil engineering and environmental engineering are offered to graduates of recognized undergraduate curricula. Both degree programs have thesis and non-thesis options. It is the policy of the department that students supported by university-related financial aid complete an integrated project, which is defined as a Thesis (Civil Engineering/Environmental Engineering 500) or Special Problem (Civil Engineering/Environmental Engineering 590). The appointment letter may specify which of the two options must be selected.

Civil Engineering Major

Departmental requirements provide that for a major in civil engineering, the bachelor’s degree must be in civil engineering, or certain undergraduate prerequisite courses must be taken before Admission to Candidacy. The Department of Civil and Environmental Engineering offers both thesis and non-thesis options for the Master of Science with a major in civil engineering. Either option must be approved by the student’s major professor.

Thesis Option

A minimum of 30 semester hours of approved graduate courses, including 6 hours of thesis, is required.

Non-Thesis Option

A minimum of 33 semester hours of approved graduate courses, is required, which may include a 3-hour special problems course to be completed under the direction of the student’s major professor.

Environmental Engineering Major

For a Master of Science with a major in environmental engineering, normally a bachelor’s degree in a field of engineering is required. For a student who does not have an engineering background, the following minimum prerequisite courses will be required: Engineering Fundamentals 151, 152; Statistics 251; Civil Engineering 380, 390, and 395 or 416; Mathematics 141, 142, 231, 241; Chemistry 120, 130. In general, these must be completed with a B average before courses for graduate credit can be taken. The Department of Civil and Environmental Engineering offers both thesis and non-thesis options for the Master of Science with a major in environmental engineering. Either option must be approved by the student’s major professor.

Thesis Option

A minimum of 30 semester hours of approved graduate courses, including 6 hours of thesis and a minimum of 15 semester hours of approved environmental engineering coursework, is required. A minor may be selected but is not required.

Non-Thesis Option

A minimum of 33 semester hours of approved graduate courses is required, which may include a 3-hour special problems course to be completed under the direction of the student’s major professor. The major shall include a minimum of 18 semester hours of approved environmental engineering coursework including a minimum of 9 semester hours of
advanced engineering design courses selected from a list provided by the student’s committee. A minor may be selected but is not necessarily required.

DOCTOR OF PHILOSOPHY

Civil Engineering Major

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

- A minimum of 72 semester hours beyond the bachelor’s degree, exclusive of credit for the MS thesis. Of this number, a minimum of 24 semester hours in 600 level Doctoral Research and Dissertation will be required. It is expected that the research work will be in journal publication form prior to approval of the dissertation.
- A minimum of 18 semester hours of graduate courses in civil engineering or environmental engineering, exclusive of thesis or dissertation credit, at least 6 hours of which must be 600-level courses.
- Additional coursework in civil engineering, environmental engineering, or related scientific and engineering fields, amounting to a minimum of 18 semester hours, subject to approval by the student’s faculty committee. These related fields will normally include such disciplines as mechanics, chemistry, mathematics, microbiology, physics, and other engineering fields. A minimum of 6 semester hours of mathematics will be required beyond the civil engineering undergraduate requirements.
- At the discretion of the student’s dissertation committee and depending on the student’s background, more than 36 hours of courses may be required.
- A maximum of 24 course credits from the master’s degree may be used to satisfy the course requirements for the PhD.
- One foreign language if the student’s faculty committee feels that a reading knowledge of a foreign language is crucial to the student’s research efforts.
- Upon completion of at least one-half of all coursework, each student must pass a comprehensive examination.

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

Environmental Policy Minor

The department participates in a program designed to give graduate students an opportunity to develop an interdisciplinary specialization in environmental policy. See Department of Economics for program description.
The requirements outlined below apply to graduate degrees in both electrical engineering and computer engineering. The research project emphasis and/or the specific courses taken will determine the actual degree awarded.

**Master of Science**

**Computer Engineering Major · Electrical Engineering Major**

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

**ADMISSION**

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

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

**REQUIREMENTS**

Students may choose between a thesis option, a non-thesis course-only option, and a non-thesis project option MS program. All students must file a Master’s Program Plan with the departmental graduate committee specifying which option they have selected, a semester-by-semester schedule of the courses they intend to take, and the members of the student’s master’s committee. Students may change between options one time by filing an amended Master’s Program Plan and with approval of the departmental graduate committee. A student who receives financial support under a research assistantship is enrolled in the thesis option by default. Students who have held a research assistantship will require approval from the departmental graduate committee to change to one of the non-thesis options. Candidates for the MS with a major in computer engineering are required to take at least two courses from the ECE 55x series as part of their curriculum.

**Thesis Option**

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

- An additional 18 semester hours of 400-level* or above work in electrical and computer engineering, with at least 6 hours of 500-level or 600-level work in each of two areas of electrical and computer engineering.
- Master’s thesis, totaling 6 semester hours.
- A final oral examination covering the thesis and related coursework.

**Non-Thesis Courses Only Option**

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

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

**Non-Thesis Project Option**

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

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

*NOTE: At least two thirds of the minimum required hours must be taken in courses numbered at or above the 500 level.
In addition, the student must satisfy requirements 2 through 7 below.

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

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

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

5. Participation in departmental seminars.


7. Successful public defense of the dissertation by the student.
Department of
INDUSTRIAL AND INFORMATION
ENGINEERING
http://www.engr.utk.edu/ie/
Adeleji B. Badiru, Head
Denise F. Jackson, Graduate Liaison

Professors
Badiru, A.B., PhD, PE .................................................Central Florida
Ding, F., PhD ..........................................................North Carolina State
Garrison, G.W. (UTSI), PhD, PE ..............................North Carolina State
Kuo, W. (Dean and University Distinguished Professor), PhD .......Kansas State

Associate Professors
Aikens III, C.H., PhD ..................................................Tennessee
Hailey, M.L. (UTSI), PhD, PE ......................................Texas Tech
Jackson, D.F., PhD, PE .............................................Tennessee
Sawhney, R.S., PhD ..................................................Tennessee

Assistant Professors
Ford, R.E., PhD ..........................................................Tennessee
Jeong, M., PhD .........................................................Georgia Tech
Kim, D., PhD ..........................................................Florida
Kong, D., PhD ..........................................................Penn State

Research Faculty and Staff
Halstead, P.D., BS .....................................................State University of New York

MAJOR DEGREES
Industrial Engineering ............................................. MS, MS-MBA, PhD

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

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

ADMISSION

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

• three rating forms or letters of reference
• GRE scores
• essay (two double-spaced pages—contact department for current topic)

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

MASTER OF SCIENCE
Industrial Engineering Major

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

Industrial Engineering Concentration

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

Information Engineering Concentration

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

Engineering Management Concentration

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

Human Factors Engineering Concentration

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

Manufacturing Systems Engineering Concentration

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

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

DUAL MS-MBA

Curriculum for Dual MS-MBA Industrial Engineering Major • Manufacturing Systems Engineering or Product Development and Manufacturing

August—First Year
Business Administration 511 MBA Core I ............................................. 3

Fall—First Year
Business Administration 512 MBA Core II ............................................. 15
Industrial Engineering 504 ................................................................. 1

Spring
Business Administration 513 MBA Core III ............................................. 9
Industrial Engineering 506 ................................................................. 2
Industrial Engineering 508 ................................................................. 3

Summer
Internship .......................................................................................... —
Industrial Engineering 509 ................................................................. 1

Fall—Second Year
Industrial Engineering 509 ................................................................. 1
Industrial Engineering Core Courses ..................................................... 9

Spring
MBA Hub Course Elective ................................................................. 3
Industrial Engineering 509 ................................................................. 1
Industrial Engineering Concentration Courses ................................. 9
Summer (first session)
Industrial Engineering 594................................................................. 3

Total 60

DOCTOR OF PHILOSOPHY
Industrial Engineering Major

ADMISSION

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

REQUIREMENTS

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

Graduate Certificate in Engineering Management

The Industrial and Information Engineering Department of the College of Engineering offers a graduate certificate in engineering management. The program is designed for professionals who work in an engineering organization and are interested in improving their technical management skills and knowledge. The program consists of four graduate courses that are available through distance education.

The 12-semester hour graduate certificate is earned by completing the following four regularly offered courses: Engineering Management 533, 534, 536, and 539.

Graduate certificate credit will be awarded for any course successfully completed with an average of B or better. The credits may be utilized toward a graduate degree later if the student meets all other degree requirements.

Applicants must meet the minimum admission requirements and be admitted to the University of Tennessee, Knoxville Graduate School. The only academic prerequisite for the certificate program is a bachelor’s degree from a recognized university or college.

Graduate Certificate in Maintenance and Reliability Engineering

The College of Engineering offers a graduate certificate in maintenance and reliability engineering. The program is designed primarily for part-time students in that several of the courses are available through distance education. The 12-semester hour credit certificate is earned by completing 483 and 484, which are cross-listed among all participating departments in the College of Engineering, plus two elective courses selected from a list of courses provided by the participating departments. Currently, the available elective courses are Industrial Engineering 516 and 591, Mechanical Engineering 534 and 599, and Nuclear Engineering 579 and 585. The selection of elective courses is determined through an advising conference with each individual student, and is based on the student’s personal interests, academic background, and work experience. Applicants must meet the minimum criteria established by the Graduate Council.
Department of
MATERIALS SCIENCE AND ENGINEERING

http://www.egr.utk.edu/msc/

Raymond A. Buchanan, Head and Graduate Liaison

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

Emeriti Faculty
Keppens, V., PhD ...............................................................Katholieke Universiteit Leuven (Belgium)
Hu, B., PhD ..............................................................................Chinese Academy of Sciences
Keppens, V., PhD ...............................................................Katholieke Universiteit Leuven (Belgium)
Rack, P.D., PhD .................................................................Florida
Rawn, C.J., PhD .................................................................Arizona

Associate Professors
Kit, K., PhD ............................................................................Delaware
Meek, T.T., PhD .................................................................Ohio State

Assistant Professors
Choo, H., PhD ........................................................................Illinois Institute of Technology
Hu, B., PhD ..............................................................................Chinese Academy of Sciences
Keppens, V., PhD ...............................................................Katholieke Universiteit Leuven (Belgium)
Rack, P.D., PhD .................................................................Florida
Rawn, C.J., PhD .................................................................Arizona

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

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

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

ADMISSION

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

MASTER OF SCIENCE

Materials Science and Engineering Major - Polymer Engineering Major

Thesis Option

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

- A major consisting of 12 hours of graduate courses in materials science and engineering or polymer engineering. The materials science and engineering major must include 511, 512, 515, and 516 for the metallurgy concentration; 511, 512, 540, and 541 for the polymers concentration; 511, 512, 540, 552, and 553 for the tissue concentration; and 511, 512, and two graduate specialization courses approved by the student’s faculty committee for the materials concentration. The polymer engineering major must include 540, 541, 543, 546, 549, and 550 for the polymer processing and polymer science concentrations; and 540, 541 or 543, 549, 550, 552, and 553 for the tissue science concentration; exceptions are given if similar material has been covered in prior coursework.
- Additional courses up to 12 hours total in related areas.
- Master’s thesis 500, totaling 6 to 12 hours.
- Satisfactory performance on a comprehensive oral examination administered by the faculty committee.

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

Non-Thesis Option

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

- Completion of a total of 30 hours of graduate coursework. At least 18 of those hours must be in the department, and up to 12 hours may be in related areas. Three hours of Materials Science and Engineering 503 or 504
may be counted toward degree requirements. The materials science and engineering major and the polymer engineering major must include the same courses required for the thesis option. The faculty committee must approve the candidate’s degree program.

- Satisfactory completion of a culminating experience Materials Science and Engineering 580 (Critical Review) as this course shall include a comprehensive examination administered by the faculty committee.

**DUAL MS-MBA**

**Curriculum For Dual MS-MBA Materials Science and Engineering Major**

**August—First Year**
Business Administration 511 MBA Core I ........................................ 3

**Fall—First Year**
Business Administration 512 MBA Core II .................................... 15
Mechanical Engineering 504 .......................................................... 1

**Spring**
Business Administration 513 MBA Core III ................................. 9
Mechanical Engineering 506 ............................................................ 2
Mechanical Engineering 508 ......................................................... 3

**Summer**
- Internship .......................................................................................
Materials Science and Engineering 509 ........................................... 1

**Fall—Second Year**
Materials Science and Engineering 509 ........................................ 1
- Departmental/Engineering Courses .............................................. 9

**Spring**
- MBA Hub Course Elective .............................................................. 3
Materials Science and Engineering 509 ........................................... 1
- Departmental/Engineering Courses .............................................. 9
Materials Science and Engineering 594 ........................................... 3

Total 60

- Approved related-area courses for the MSE non-thesis Master of Science requirements
- Departmental/Engineering Courses must fulfill MSE non-thesis Masters of Science requirements
- MSE 594 is an approved substitute for MSE 580 for the dual degree program

**DOCTOR OF PHILOSOPHY**

**Materials Science and Engineering Major - Polymer Engineering Major**

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

**REQUIREMENTS**

Departmental requirements for completion of the doctoral degree are:

- For students proceeding directly to the PhD from the baccalaureate degree, a minimum of 72 graduate credit hours is required. These hours must include 42 graduate course credit hours with at least six hours of 600-level courses and 30 hours of dissertation. Six hours of Materials Science and Engineering 503 or 504 may be counted toward degree requirements. At least 24 credit hours must be courses taught in the department. The materials science and engineering major and the polymer engineering major must include the courses required for the master’s program. In addition, for students in the textile science concentration of the polymer engineering major, the courses must include 541 and 543.

- For students having a thesis-based master’s degree from UT in materials science and engineering or polymer engineering, or a master’s degree from another university in materials science and engineering, polymer engineering, or metallurgical engineering, a minimum of 48 graduate credit hours is required. These hours must include 18 graduate course credit hours with at least six hours of 600-level courses and 30 hours of dissertation. Three hours of Materials Science and Engineering 503 or 504 may be counted toward degree requirements. At least 12 credit hours must be courses in the department.

- Active participation in graduate seminars conducted by the department.

**Department of**

**MECHANICAL, AEROSPACE, AND BIOMEDICAL ENGINEERING**

http://www.egr.utk.edu/maes/

William Hamel Interim Head
Gary V. Smith, Graduate Liaison

**Professors**
Arimilli, R.V., PhD ............................................................Virginia Tech
Baker, A.J., PhD, PE .....................................................New York
Dareing, D.W., PhD, PE ..................................................Illinois
Frankel, J.I., PhD ..........................................................Virginia Tech
Hamel, W.R., PhD ............................................................Tennessee
Jendrucko, R.J., PhD, PE ..............................................Virginia
Johnson, W.S., PhD, PE ....................................................Tennessee
Keyhani, M., PhD .................................................................Ohio State
Kihm, K.D., PhD ...............................................................Stanford
Komistek, R.D., PhD ..............................................................Memphis
Landes, J.D., PhD, PE .............................................................Lehigh
Milligan, M.W., PhD PE ....................................................Penn State
Parang, M. (Associate Dean), PhD, PE ..............................Oklahoma
Parsons, J.R., PhD, PE .....................................................North Carolina State
Smith, G.V., PhD, PE ............................................................Penn State
Soliman, O., PhD, PE ............................................................Tennessee
Speckhart, F.H., PhD, PE ......................................................Georgia Tech
Wasserman, J.F., PhD, PE ..............................................Cincinnati
Weitsman, Y.J. (Distinguished Professor), PhD ...............................Rensselaer Polytechnic Institute

**Associate Professors**
Boulet, J.A.M., PhD ..........................................................Stanford
Chellaboina, V.S., PhD .....................................................Georgia Tech
Freeman, J.S., PhD ..............................................................Wisconsin
Karsa, M., PhD .................................................................Ecole Polytechnique (Canada)
Lumsdaine, A., PhD.........................................................Michigan
Lyne, J.E., MD, PhD .................................................... North Carolina State
Madhuvar, MS, PhD ..........................................................Drexel
Nguyen, K., PhD .............................................................Colorado
Ponke, C.D., PhD, PE ..........................................................Georgia Tech

Assistant Professors
Bond, R.E., PhD .................................................................West Virginia
English, A., PhD .............................................................Massachusetts Institute of Technology
Mahfouz, M.R., PhD .........................................................Colorado School of Mines

Emeriti Faculty
Carley, T.G., PhD, PE ..........................................................Illinois
Forrester, J.H., PhD, PE ......................................................Iowa State
Hodgson, L., PhD, PE ..........................................................Georgia Tech
Mathews, A., PhD, PE .........................................................Illinois
Shannon, T.E., PhD, PE ......................................................Tennessee
Snyder, W.T., PhD ............................................................Northwestern

MAJOR DEGREES
Aerospace Engineering .............................................MS, MS-MBA, PhD
Biomedical Engineering .............................................MS, MS-MBA, PhD
Engineering Science ................................................MS, MS-MBA, PhD
Mechanical Engineering ..........................................MS, MS-MBA, PhD

Graduate programs leading to the degrees of Master of Science and Doctor of Philosophy are available with majors in mechanical engineering, aerospace engineering, and engineering science. Changing from one of these programs to another requires departmental approval. Each applicant is advised as to any prerequisite courses before entering a program. A dual MS-MBA program with a concentration in product development and manufacturing is also available with a major in mechanical engineering or in engineering science.

In mechanical engineering, program concentrations include dynamics, control, and robotics; energy conversion and utilization; gas dynamics; heat transfer and fluid mechanics; machine design; power generation; product development and manufacturing (MS only); propulsion; space engineering; stress analysis; and thermodynamics.

In aerospace engineering, program concentrations include aeroacoustics; aerodynamics and performance; energy conversion and utilization; flight and aerospace mechanics; gas dynamics; heat transfer and fluid mechanics; propulsion; space engineering; structures and stress analysis; and thermodynamics.

In biomedical engineering, program concentrations include musculoskeletal biomechanics; biofluid mechanics; biomaterials; bioimaging; and cell and tissue engineering.

In engineering science, program concentrations include applied artificial intelligence, biomedical engineering, computational mechanics, fluid mechanics, mechanics of composite materials, solid mechanics, industrial engineering (PhD only), product development and manufacturing (MS only), optical engineering (UTSI only). In each of these concentrations, interdisciplinary programs are arranged to meet individual needs or interests. The flexibility and interdisciplinary aspect of the program concentrations are intended to be of particular interest to prospective students currently employed in research, development, or design activities and whose interests in continuing education (either full-time or part-time) lie at one of the interfaces between science and engineering or can best be met by interdisciplinary study in engineering. The program’s course offerings and research activities are also intended to meet the needs of students who seek preparation for employment in engineering areas requiring specialization in mechanics or in related interdisciplinary studies such as bio-mechanics.

In mechanical engineering or aerospace engineering, entrance into the Master of Science program is available to qualified graduates of recognized undergraduate curricula in mechanical or aerospace engineering and to qualified graduates of other curricula who satisfy the necessary prerequisites. A program application is required in addition to the Graduate Application for Admission. Admission into the doctoral program will be granted to those applicants who have demonstrated superior achievement in their engineering backgrounds. The general GRE is required of all applicants for admission.

In Biomedical Engineering, entrance into the graduate program is available to graduates of recognized curricula in engineering, mathematics, or one of the physical sciences who satisfy the necessary prerequisites. A program application is required in addition to the Graduate Application for Admission. The names and addresses of three references must be included with the program application. The general GRE is required of all applicants for admission.

In engineering science, entrance into the graduate program is available to graduates of recognized curricula in engineering, mathematics, or one of the physical or biological sciences. A program application is required in addition to the Graduate Application for Admission. The names and addresses of four references must be included with the program application. The general GRE is required of all applicants for admission.

Each student must satisfactorily complete a program of study that has been approved by his/her advisory committee and complies with the requirements of the Graduate Council. In engineering science, the student’s major professor may be selected from a department other than the Department of Mechanical, Aerospace, and Biomedical Engineering; however, at least one member of the student’s graduate advisory committee must be on the faculty of the Department of Mechanical, Aerospace, and Biomedical Engineering.

GRADUATE CREDIT FOR UNDERGRADUATE COURSES

Students majoring in mechanical engineering or aerospace engineering may not normally use more than one 400-level engineering course to meet their advanced degree requirements. Undergraduate courses that are required for the bachelor’s degree in mechanical engineering may not be taken for graduate credit by graduate students in mechanical engineering. Undergraduate courses that are required for the bachelor’s degree in aerospace engineering may not be taken for graduate credit by graduate students in aerospace engineering. For students majoring in engineering science, 400-level courses in engineering may be used for graduate credit at the discretion of the advising committee. However, at least two-thirds of minimum required credit hours in a master’s degree program must be at or above the 500-level. With the approval of the student’s major department, a student whose major is outside the Department of Mechanical, Aerospace, and Biomedical Engineering may take senior (400-level) courses in the department for graduate credit. Such students should consult with instructors regarding prerequisites for undergraduate courses.
MASTER OF SCIENCE

Aerospace Engineering Major • Biomedical Engineering Major • Engineering Science Major • Mechanical Engineering Major

REQUIREMENTS

In aerospace engineering, mechanical engineering, biomedical engineering, and engineering science, two MS options are offered. Option I requires a thesis and is the normal program for graduate students. Option II does not require a thesis and provides graduate students, including co-op and other off-campus students, the opportunity to focus their programs in special areas through extended coursework.

Aerospace Engineering Major • Mechanical Engineering Major

Credit requirements for these two options in Mechanical Engineering and Aerospace Engineering are:

<table>
<thead>
<tr>
<th>Hours Required</th>
<th>Option I</th>
<th>Option II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coursework total</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>• Courses in program (500-level or above)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Option I – 12 hours minimum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Option II – 18 hours minimum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Mathematics (400-level or above)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 hours minimum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 590 Selected Engineering Problems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Option II – 6 hours maximum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thesis</td>
<td>6</td>
<td>n/a</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

Biomedical Engineering Major

Credit requirements for these two options in biomedical engineering are:

<table>
<thead>
<tr>
<th>Hours Required</th>
<th>Option I</th>
<th>Option II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coursework total</td>
<td>24</td>
<td>30</td>
</tr>
<tr>
<td>• Engineering courses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Option I – 12 hours minimum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Option II – 15 hours minimum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Mathematics (400-level or above)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 hours minimum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Related courses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Option I – 6 hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Option II – 9 hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(590 Selected Engineering Problems)</td>
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<td></td>
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<tr>
<td>- 6 hours maximum. May include</td>
<td></td>
<td></td>
</tr>
<tr>
<td>additional courses in mathematics,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>computer science, or the physical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>and life sciences, as well as</td>
<td></td>
<td></td>
</tr>
<tr>
<td>engineering courses.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thesis</td>
<td>6</td>
<td>n/a</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

Engineering Science Major

Credit requirements for these two options in engineering science are:

<table>
<thead>
<tr>
<th>Hours Required</th>
<th>Option I</th>
<th>Option II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coursework total</td>
<td>24</td>
<td>30</td>
</tr>
<tr>
<td>• Engineering courses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Option I – 12 hours minimum</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For all program options, other 500-level engineering courses that are approved by the student’s master’s committee and the graduate programs committee may be substituted for the mathematics courses. All program options require participation in the departmental graduate seminars program, and passing a final examination on all work submitted for the degree. The final examinations in Option II will cover all coursework. The thesis option, Option I, requires submission and defense of a written thesis that demonstrates the ability to conduct and report an independent investigation.

DUAL MS-MBA

Curriculum for Dual MS-MBA Degree • Aerospace Engineering Major

<table>
<thead>
<tr>
<th>August—First Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Administration 511 MBA Core I</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fall—First Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Administration 512 MBA Core II</td>
</tr>
<tr>
<td>Mechanical Engineering 504</td>
</tr>
</tbody>
</table>

Spring

| Business Administration 513 MBA Core III | 9 |
| Mechanical Engineering 506 | 2 |
| Mechanical Engineering 508 | 3 |

Summer

- Internship
- Aerospace Engineering 509 | 1 |

Fall—Second Year

| Aerospace Engineering 509 | 1 |
| - Departmental/Engineering Courses | 9 |

Spring

- MBA Hub Course Elective | 3 |
| Mechanical Engineering 509 | 1 |
| - Departmental/Engineering Courses | 9 |

Summer (first session)

| Mechanical Engineering 594 | 3 |

Total 60

Curriculum for Dual MS-MBA Degree • Biomedical Engineering Major

<table>
<thead>
<tr>
<th>August—First Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Administration 511 MBA Core I</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fall—First Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Administration 512 MBA Core II</td>
</tr>
<tr>
<td>Mechanical Engineering 504</td>
</tr>
</tbody>
</table>
### Curriculum for Dual MS-MBA Degree • Mechanical Engineering Major

**August—First Year**
- Business Administration 511 MBA Core I ................................................. 3

**Fall—First Year**
- Business Administration 512 MBA Core II .............................................. 15  
  - Mechanical Engineering 504 ................................................................. 1

**Spring**
- Business Administration 513 MBA Core III ............................................. 9  
  - Mechanical Engineering 506 ................................................................. 2  
  - Mechanical Engineering 509 ................................................................. 3

**Summer**
- Internship ............................................................................................. —  
  - Mechanical Engineering 509 ................................................................. 1

**Fall—Second Year**
- Mechanical Engineering 509 ................................................................. 1  
  - Engineering Courses .............................................................................. 9

**Spring**
- MBA Hub Course Elective ...................................................................... 3  
  - Mechanical Engineering 509 ................................................................. 1  
  - Engineering Courses .............................................................................. 9

**Summer (first session)**
- Mechanical Engineering 594 ................................................................. 3

**Total 60**

### Curriculum for Dual MS-MBA Degree • Engineering Science Major

**August—First Year**
- Business Administration 511 MBA Core I ................................................. 3

**Fall—First Year**
- Business Administration 512 MBA Core II .............................................. 15  
  - Mechanical Engineering 504 ................................................................. 1

**Spring**
- Mechanical Engineering 509 ................................................................. 1  
  - Mechanical Engineering 551 ................................................................. 3  
  - Mechanical Engineering 537 ................................................................. 3  
  - Mechanical Engineering 527 ................................................................. 3

**Fall—Second Year**
- Mechanical Engineering 509 ................................................................. 1  
  - Mechanical Engineering 505 ................................................................. 3  
  - Mechanical Engineering 508 ................................................................. 3  
  - Engineering Courses .............................................................................. 3

**Spring**
- MBA Hub Course Elective ...................................................................... 3  
  - Mechanical Engineering 509 ................................................................. 1  
  - Mechanical Engineering 510 ................................................................. 3  
  - Math/Engineering Elective (select with advisor) .................................. 3

**Summer (first session)**
- Mechanical Engineering 594 ................................................................. 3

**Total 60**

Dual degree candidates enrolled in engineering science are required to take 18 hours of graduate level engineering courses during the second year of the program. This program requires a coursework plan, approved by the Dual Program Committee, including a concentration such that the student can accomplish his/her teamwork assignments.

### DOCTOR OF PHILOSOPHY

**Aerospace Engineering Major • Biomedical Engineering Major • Engineering Science Major • Mechanical Engineering Major**

**REQUIREMENTS**

All students must complete a minimum of 72 semester hours beyond the bachelor’s degree, exclusive of credit for the master’s thesis. These shall include a minimum of 24 semester hours in Doctoral Research and Dissertation and a minimum of 48 semester hours in other courses.

In mechanical engineering, aerospace engineering, or biomedical engineering, the courses must include:

- A minimum of 12 semester hours of graduate credit in mathematics in courses numbered 400 or above with a minimum of 6 semester hours numbered 500 or above.
- A minimum of 24 semester hours in the department in courses numbered 500 and above, with at least 12 of these semester hours in the major. A minimum of 9 semester hours of courses is required at the 600 level. These are exclusive of thesis, problems, or dissertation credit. The student’s advisory committee can approve a student’s petition to replace one 600-level course with one or more 500-level course(s) that are more appropriate.
- In engineering science, the courses must include:
  - A minimum of 12 semester hours in mathematics or computer science in courses numbered 400 and above, exclusive of a first course in ordinary differential equations.
• Additional requirements for all students include
• Registration and participation in the graduate seminar in the major program.
• Meet all departmental examination requirements, which include passing a written and oral comprehensive examination.
• Presentation of a dissertation proposal to the student’s advisory committee and approval of that proposal by that committee.
• Successful defense of the dissertation.

Graduate Certificate in Computational Fluid Dynamics

The College of Engineering offers a graduate certificate in computational fluid dynamics (CFD). The program is designed primarily for the part-time student interested in gaining dexterity in this subject by taking a course sequence through distance education. All course work is permanently archived at the College of Engineering Computational Fluid Dynamics Laboratory Web site, hence available on demand on a totally flexible schedule.

The 12-hour certificate is earned by completing the three courses, Engineering Science 551, 552, and 581 (CFD Laboratory), which are extensively cross-listed among departments in the College of Engineering. The certificate is completed with one elective three-hour course from an approved list. Those currently approved are Chemical Engineering 507 and Electrical and Computer Engineering 599 (Computer Fire Modeling). A wider selection of courses will be added when they become available.

The sole academic prerequisite for the certificate program is a bachelor’s degree in engineering. Applicants must meet the minimum admission requirements of the University of Tennessee, Knoxville, Graduate School and become admitted thereto.

Graduate Certificate in Maintenance and Reliability Engineering

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

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

Department of Nuclear Engineering

http://www.engr.utk.edu/nuclear/

H. L. Dodds, Head and Graduate Liaison

Professors
Dodds, H.L. (IBM Professor), PhD, PE ..................................Tennessee
Fontana, M.H. (Research), PhD, PE ......................................Purdue
Groer, P.G., PhD .............................................................Vienna (Austria)
Grossbeck, M.L. (Research), PhD ........................................Illinois
Mihalcz, J.T. (Research), PhD ..............................................Tennessee
Miller, L.F., PhD, PE ..........................................................Texas A&M
Mynatt, F.R. (Research), PhD ..............................................Tennessee
Pettengill, H.J. (Research), PhD .............................................Michigan
Ruggles, A.E., PhD ......................................................Rensselaer Polytechnic Institute
Townsend, L.W., PhD ....................................................Idaho
Upadhyaya, B.R., PhD, PE ................................................California (San Diego)

Associate Professors
Hines, J.W., MBA, PhD ................................................Ohio State
Pevy, R.E., MBA ..............................................................Emory
PhD, PE ..............................................................Tennessee
Scott, T.H., PhD, PE .........................................................Florida

Assistant Professors
Gribok, A.V. (Research), PhD ........................................IPPE (Russia)
Moussa, H.M. (Research), PhD ........................................Tennessee
Stephan, A.C. (Research), PhD ........................................Tennessee

Adjunct Faculty
DeHart, M.D., PhD ..................................................Texas A&M
Gelmin, J.C., PhD ....................................................Massachusetts Institute of Technology
Icenhour, A.S., PhD ................................................Tennessee
Nichols, T.L., MD ......................................................Tennessee
Ramsey, C.R., PhD ..................................................Tennessee

Emeriti Faculty
Kent, T.W., PhD .............................................................Tennessee
Uhlig, R.E. (Distinguished Professor), PhD, PE ............Iowa State

MAJOR DEGREES
Nuclear Engineering ........................................................MS, PhD

The Department of Nuclear Engineering offers programs leading to the Master of Science and Doctor of Philosophy degrees. Students may elect a traditional nuclear engineering program focusing on fission energy or fusion energy, or a radiological engineering concentration, which prepares students for careers in the radiation safety field (health physics). Both programs are designed for graduates of accredited undergraduate programs in engineering, physics, chemistry, biology, or mathematics.

All entering students must have, as a minimum, competency in mathematics through ordinary differential equations, competency in atomic and nuclear physics, and competency consistent with an introductory course in nuclear engineering. If such competencies do not exist, the student must take appropriate courses for undergraduate credit. In addition, students without a BS in nuclear engineering, or the equivalent, must take 431 (Radiation Protection) and 470 (Nuclear Reactor Theory I), both of which may be taken for graduate credit. The department head is the contact for all interested students, both those with nuclear engineering degrees and those from other disciplines.
Graduate Credit for Undergraduate Courses

400-level courses in nuclear engineering may be used for graduate credit. However, at least two-thirds of the minimum required hours in the MS must be taken in courses numbered 500 or above.

MASTER OF SCIENCE
Nuclear Engineering Major

A graduate program leading to the Master of Science degree is available to graduates of recognized undergraduate curricula as described above. Each applicant will be advised as to the necessary prerequisite courses before he/she enters the program.

REQUIREMENTS

The minimum requirements for the MS in nuclear engineering are

- a major consisting of 12 hours of graduate courses in nuclear engineering which must include at least one of the following sequences: 511, 512; 521, 522; 551, 552; 571, 572; 581, 582
- a minor consisting of six hours of elective courses in mathematics, statistics or computer science
- six hours in either nuclear engineering or a related field
- one of the following three options for a culminating experience
  a. a thesis project (six hours of 500)
  b. two to four engineering practice projects (six hours of 598)
  c. one engineering practice project (three hours of 598) plus six hours of additional nuclear engineering coursework

Thus, options a and b result in a minimum total of 30 hours and option c results in a minimum total of 33 hours. The determination of which option a student may undertake is made by the student’s graduate committee and is based on the student’s personal interests, academic background, and work experience, as well as the nature of projects currently available in the department.

A thesis project requires the student to conduct independent, in-depth research. An engineering practice project is similar to a thesis project but smaller in scope, and can be research, design, product development, special operations, or a critical review of published literature in a specific technical area. The student must submit a brief written proposal for each project undertaken, either thesis or engineering practice, which must be approved by the student’s graduate committee. The final report for an engineering practice project is normally prepared in thesis format (i.e., according to the UT Knoxville Guide to the Preparation of Theses and Dissertations); however, another formal report format may be used if approved by the student’s graduate committee. The student must also register for the appropriate number of hours of either 500 or 598, as specified by the student’s major professor, during each semester that work is performed on a thesis or engineering practice project. Finally, the student must pass an oral examination on all work presented for the degree—all coursework and all projects.

The MS in nuclear engineering is also available to distance students via selected courses that are delivered synchronously over the Web to the student’s computer. More detailed information about this distance program is located at http://www.anywhere.tennessee.edu/ne/default.htm.

DUAL MS-MBA

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

ADMISSION

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

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

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

REQUIREMENTS

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

During the second year, dual degree candidates will also take courses in their engineering major. The coursework is designed to provide students with a concentration in their major and advanced skills to accomplish their teamwork assignments. Dual degree candidates enrolled in nuclear engineering are required to take 18 hours of graduate-level nuclear engineering
courses during the second year of the program, which must be approved by the student’s Dual Program Committee Advisor. In addition, a dual degree candidate who majors in nuclear engineering must successfully defend, in an oral examination administered by at least three nuclear engineering faculty members including the student’s Dual Program Committee Advisor, all work presented for the MS degree—all coursework and the culminating integrated project.

**DUAL MS-MBA**

**Curriculum for Dual MS-MBA Degree • Nuclear Engineering Major**

<table>
<thead>
<tr>
<th>August—First Year</th>
<th>Business Administration 511 MBA Core I</th>
<th>3</th>
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<tbody>
<tr>
<td>Fall—First Year</td>
<td>Business Administration 512 MBA Core II</td>
<td>15</td>
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<tr>
<td></td>
<td>Mechanical Engineering 504 Product Development Process</td>
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<tr>
<td>Spring</td>
<td>Business Administration 513 MBA Core III</td>
<td>9</td>
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<tr>
<td></td>
<td>Mechanical Engineering 506 Product Selection and Evaluation</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Mechanical Engineering 508 Integrated Product, Process, and Manufacturing System Design</td>
<td>3</td>
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<tr>
<td>Summer</td>
<td>—Internship</td>
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<tr>
<td></td>
<td>Nuclear Engineering 509 Project Management</td>
<td>1</td>
</tr>
<tr>
<td>Fall — Second Year</td>
<td>Nuclear Engineering 509 Project Management</td>
<td>1</td>
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<tr>
<td></td>
<td>—Nuclear Engineering Courses</td>
<td>9</td>
</tr>
<tr>
<td>Spring</td>
<td>—MBA Hub Course Elective</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Nuclear Engineering 509 Project Management</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>—Nuclear Engineering Courses</td>
<td>9</td>
</tr>
<tr>
<td>Summer (first session)</td>
<td>Nuclear Engineering 594 Culminating Integrated Project Report</td>
<td>3</td>
</tr>
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<td></td>
<td>Total 60</td>
<td></td>
</tr>
</tbody>
</table>

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

**DOCTOR OF PHILOSOPHY**

**Nuclear Engineering Major**

Students in the field of nuclear engineering desiring to study for the Doctor of Philosophy degree must have a Bachelor of Science or Master of Science from a recognized university with a major in engineering, physics, chemistry, biology, or mathematics. All candidates will be required to demonstrate general competence in a comprehensive examination in the areas of engineering science, mathematics, chemistry, physics, and nuclear engineering.

**REQUIREMENTS**

Specific requirements for the PhD in nuclear engineering include:

- A minimum of 48 hours beyond the bachelor’s degree, exclusive of credit for the MS thesis or nuclear engineering practice.
- A minimum of 24 hours in doctoral research, Nuclear Engineering 600.
- A minimum of 30 hours in nuclear engineering courses numbered 500 and above (or the equivalent), with at least nine hours of 600-level courses. These are exclusive of thesis or dissertation credit. Three of the nine hours of 600-level courses can be from a department other than nuclear engineering provided the selection supports the student’s research area.
- A minimum of 12 hours in mathematics, computer science, or statistics courses beyond nuclear engineering undergraduate requirements numbered 400 or above.
- A minimum of six hours in courses numbered 500 or above from a department other than nuclear engineering. The choice depends on the student’s overall program and should expand his/her knowledge in a given field.

The first part of the comprehensive examination is prepared by the nuclear engineering faculty and consists of 12 hours of written examination that is administered over a three-day period. All past written examinations are filed in the library, and students are encouraged to review them. Students are invited to take the written examination after completing approximately 30 hours of graduate coursework. A student who fails the written examination must take and pass the examination the next time it is offered to remain in the PhD program. Registration for 600 is not permitted until the written examination is passed. The second part of the comprehensive examination is completed with the successful oral defense of a written dissertation proposal.

A candidate must successfully defend, in an oral examination, all work presented for the degree—all coursework and the dissertation.

**Graduate Certificate in Maintenance and Reliability Engineering**

The College of Engineering offers a graduate certificate in maintenance and reliability engineering. The program is designed primarily for part-time students in that all of the courses are available through distance education (see http://www.anywhere.tennessee.edu/ne/default.htm).

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

The Department of Nuclear Engineering offers a graduate certificate in nuclear criticality safety. The program is designed primarily for part-time students in that all of the courses are available through distance education (see http://www.anywhere.tennessee.edu/ne/default.htm).

The 12-credit certificate is earned by completing 421, 543, and 582 plus one of the following three courses: 470, 571, or 581. The selection of one of the latter three courses is determined through an advising conference with each individual student, and is based on the student’s personal interests, academic background, and work experience. Applicants must meet the minimum criteria established by the Graduate Council. Students without a nuclear engineering background must take 301 (Fundamentals of Nuclear and Radiological Engineering) prior to beginning the graduate coursework described above.