The Ingram School of Engineering Mission

The Ingram School of Engineering will be a nationally recognized institution of higher education, serving students and employers with a complete set of accredited engineering programs supported by a faculty which maintains high standards of teaching, research, and service. To accomplish this vision, we will:

1. Engage undergraduate and graduate students with innovative, multidisciplinary, and nationally recognized funded research programs,
2. Emphasize quality undergraduate and graduate education using a practical, interactive, and contemporary learning environment,
3. Produce first-generation professional college graduates as part of an HSI-designated university; be recognized for exceptional community service; and create tight bonds with alumni who will serve as professional mentors, sponsors, and advisors, and
4. Promote a student-centered culture based on collegiality, scholarship, enthusiasm, integrity, and mutual respect among diverse faculty, staff, and students.

The Electrical Engineering Mission

Statement, Program Educational Objectives, and Student Outcomes

Our mission is:

To lead students to be innovative, ethical engineering professionals through solid education at the undergraduate level, by providing opportunities to participate in research, and by responding to the needs of the Central Texas region, the state of Texas, and the nation. We achieve this mission by:

- Engaging colleagues and students in new and more effective ways to transmit knowledge to the next generation of electrical and computer engineers.
- Engaging colleagues and students in pioneering, scholarly, multidisciplinary research efforts.
- Creating an inclusive environment which emphasizes ethics and integrity and fosters creativity, appreciation for all ideas, and respect for others.
- Seeking and maintaining bonds with our alumni and the industries which hire them.
- Maintaining a student-centered atmosphere for undergraduate education and research.

The objectives of the program are to produce graduates who, in 3-5 years of receiving the EE degree, attain the necessary skills and abilities to:

1. Analyze, design, develop, optimize, and implement complex systems in the context of modern interdisciplinary engineering work.
2. Contribute to the solution of practical problems in industrial, service, and government organizations by applying skills acquired through formal and lifelong learning.
3. Enjoy fulfilling engineering careers, including professional advancement, entrepreneurship, and the pursuit of graduate studies.
4. Practice engineering while observing appropriate technological, organizational, societal, global, and ethical contexts.
Each graduate is expected to have:
(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in lifelong learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
(l) a knowledge of probability, statistics, and mathematics through differential and integral calculus, differential equations, linear algebra, complex variables, and discrete mathematics
(m) a knowledge of sciences and engineering topics (including computer science) necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components.

Within 3-5 years after graduation, graduates of our IE program are expected to be able to attain the following educational objectives:
1. Perform as industry leaders in the global marketplace, capable of successfully planning, controlling, and implementing large-scale projects.
2. Understand and apply the principles of science, technology, engineering, and math involving industry-relevant problems.
3. Contribute to the profitable growth of industrial economic sectors by using IE analytical tools, effective computational approaches, and systems thinking methodologies.
4. Maintain high standards of professional and ethical responsibility.
5. Work effectively in diverse, multicultural environments emphasizing the application of teamwork and communication skills.
6. Practice life-long learning to sustain technical currency and excellence throughout one’s career. Promote the profession and its benefits to society.

Each student is expected to demonstrate:
(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in lifelong learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
(l) an ability to design, develop, implement, and improve integrated systems that include people, materials, information, equipment, and energy and to accomplish the integration of systems using appropriate analytical, computational, and experimental practices.

The Industrial Engineering Mission Statement, Program Educational Objectives, and Student Outcomes
Our mission is:
To provide an excellent and innovative education setting to our students so they can learn and discover how complex systems work better. The IE program strives to maintain a comprehensive curriculum that enables students to become leading engineers and/or creative researchers in the global marketplace and/or in graduate studies. The program seeks to collaborate with private and public sectors in the search of methodologies and creative solutions to problems that contribute to the advancement of education, technology, and professional development. Through plans and activities that search to embrace a highly diverse student population of strong diversity, the program attempts to be a significant provider of an global workforce.

The Manufacturing Engineering Mission Statement, Program Educational Objectives, and Student Outcomes
Our mission is:
• To sustain a quality, student-centered, industry-oriented engineering curriculum.
• To attract students and prepare them with the knowledge, practical skills, and abilities to perform as highly competent engineers in the global marketplace and/or in graduate studies.

• To produce graduates skilled in materials and manufacturing processes; process, assembly and product engineering; manufacturing competitiveness and systems design.

Within 3-5 years after graduation, graduates of our Manufacturing Engineering program are expected to be able to attain the following educational objectives:

1. Perform as technical leaders in the global marketplace.
2. Analyze, design, develop, implement, evaluate, and optimize complex manufacturing systems and processes in the context of modern interdisciplinary engineering work.
3. Contribute to the profitable growth of manufacturing businesses.
4. Maintain high standards of professional and ethical responsibility.

Each student is expected to demonstrate:
(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Admissions Requirements

Electrical Engineering
1. In order to declare Electrical Engineering as a major, students must meet one of the following prerequisites:
   • ACT Math score of 24 or higher,
   • SAT Math score of 520 (re-centered) or higher, or
   • credit for one of the following math courses with a grade of “C” or higher:

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>MATH 1315</td>
<td>College Algebra</td>
<td>3</td>
</tr>
<tr>
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</tr>
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<td>3</td>
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<tr>
<td>MATH 1329</td>
<td>Mathematics for Business and Economics II</td>
<td>3</td>
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2. Students who do not meet the above prerequisites may choose Pre-Electrical Engineering as their major. Pre-Electrical Engineering students who complete one of the following math courses with a grade of “C” or higher may declare Electrical Engineering as their major:

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Industrial Engineering
1. In order to declare Industrial Engineering as a major, students must meet one of the following prerequisites:
   • ACT Math score of 24 or higher,
   • SAT Math score of 520 (re-centered) or higher, or
   • credit for one of the following math courses with a grade of “C” or higher:

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2. Students who do not meet the above prerequisites may choose Pre-Industrial Engineering as their major. Pre-Industrial Engineering students who complete one of the following math courses with a grade of “C” or higher may declare Industrial Engineering as their major:

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Bachelor of Science (B.S.)

• Major in Electrical Engineering (Computer Engineering Concentration) (http://mycatalog.txstate.edu/undergraduate/science-engineering/ingram-school/electrical-engineering-computer-specialization-bs)
• Major in Electrical Engineering (Micro and Nano Devices and Systems Concentration) (http://mycatalog.txstate.edu/undergraduate/science-engineering/ingram-school/electrical-engineering-micro-nano-devices-systems-specialization-bs)
• Major in Electrical Engineering (Networks and Communication Systems Concentration) (http://mycatalog.txstate.edu/undergraduate/science-engineering/ingram-school/electrical-engineering-networks-communication-systems-specialization-bs)
- Major in Industrial Engineering (http://mycatalog.txstate.edu/undergraduate/science-engineering/ingram-school/industrial-engineering-bs)
- Major in Manufacturing Engineering (General Manufacturing Concentration) (http://mycatalog.txstate.edu/undergraduate/science-engineering/ingram-school/manufacturing-engineering-general-concentration-bs)
- Major in Manufacturing Engineering (Mechanical Systems Concentration) (http://mycatalog.txstate.edu/undergraduate/science-engineering/ingram-school/manufacturing-engineering-mechanical-systems-concentration-bs)

**Subjects in this school include:** EE (p. 4), ENGR (p. 6), IE (p. 7), MFGE (p. 8)

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**Courses in Electrical Engineering (EE)**

**EE 2400. Circuits I.**
This course provides an introduction to the profession of Electrical Engineering and its specialties. Fundamental DC and sinusoidal steady-state circuit analysis techniques include Ohm’s law, power, Kirchoff’s laws, and Thevenin and Norton equivalent circuits. Prerequisites: MATH 2471 with a grade of "C" or better.  
*3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.*

**EE 2420. Digital Logic.**
An introduction to fundamental computer technologies, including Boolean logic design, logic circuits and devices, and basic computer hardware are studied. Laboratories provide hands-on experience with electricity, combinational and sequential digital circuits, and computer hardware. Prerequisite: CS 1428 with a grade of "C" or better.  
*4 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.*

**EE 3340. Electromagnetics.**
Wave propagation, Maxwell’s equations, transmission lines, wave guides, and antennas. Prerequisites: MATH 3373 and PHYS 2435 with grades of "C" or better. Co-requisite: EE 3300 or EE 3400.  
*3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.*

**EE 3350. Electronics I.**
Analysis and design of active device equivalent circuits with emphasis on transistors, switching circuits, and operational amplifiers. Prerequisites: EE 3300 or EE 3400, all with a grade of "C" or better.  
*3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.*

**EE 3355. Solid State Devices.**
Semiconductor materials, principles of carrier motion, operating principles and circuit models for diodes, bipolar transistors and field-effect transistors. Introduction to integrated circuits. Prerequisites: EE 3300 or EE 3400 all with a grade of "C" or better.  
*3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.*

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**EE 3370. Signals and Systems.**
Frequency domain representation of signals and systems and frequency domain concepts for circuit analysis and design. Transfer function and frequency response, Laplace and z-transforms, Fourier series, Fourier transform, and sampling. Prerequisites: EE 3300 or EE 3400, with a grade of "C" or better.  
*3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.*

**EE 3400. Circuits II.**
This course includes a brief review of EE 2400, transient analysis, application of Laplace transforms, Bode plots, and network principles. Materials learning in EE 2400 is extended and applied here. Prerequisites: EE 2400 and MATH 3323, all with a grade of "C" or better.  
*4 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.*

**EE 3420. Microprocessors.**
Introduction to microprocessors, principles of operation, assembly language programming, timing analysis, and I/O interfacing. Prerequisites: EE 2420 with a grade of "C" or better.  
*4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.*

**EE 3423. Digital Image Processing.**
This course provides the necessary fundamental techniques to analyze and process digital images. It covers principles, concepts, and techniques of digital image processing and computer vision. Prerequisites: CS 1428 and EE 3420, all with a grade of "C" or better.  
*3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.*

**EE 3430. Electromagnetics.**
Analysis and design of integrated circuits, feedback, and frequency response. Prerequisites: EE 3350 with a grade of "C" or better.  
*3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.*

**EE 3435. Fundamentals of Electroceramics.**
Introduction to binary and ternary phase diagrams, non-centro-symmetric crystal structures and symmetry groups, nonlinear dielectrics (including ferroelectricity, piezoelectricity, pyroelectricity), nonlinear magnetics, oxide wideband gap semiconductors, detectors and sensors, brief introduction to MEMS, radhard electronics, and spintronics technology. Research oriented labs related to materials processing, characterization, fabrication, and testing. Prerequisite: ENGR 2300 or equivalent with a grade of "D" or better; Co-requisite: EE 3355 with a grade of "D" or better; GPA of 2.25 or higher.  
*3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.*

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EE 4352. Introduction to VLSI Design.
Analysis of design of CMOS integrated circuits. Introduction to CAD tools for VLSI design. Prerequisites: CS 2420 or EE 2420 and EE 3350, all with grades of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Course Attribute(s): Lab Required
Grade Mode: Standard Letter

Key concepts of advanced semiconductor technology including Moore’s law, MOSFETs and CMOS, CMOS scaling, high-K gate dielectrics, new channel materials replacing silicon, three dimensional device structures, compound semiconductor MESFET, HEMT, LED, Lasers and solar cells. Prerequisite: EE 3355 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

EE 4354. Flexible Electronics.
This course will cover the materials systems, processes, device physics and applications of flexible electronics. The materials range from amorphous and nanocrystalline silicon, organic and polymeric semiconductors to solution cast films of carbon nanotubes. Real device discussions include high speed transistors, photovoltaics, flexible flat panel displays, medical image sensors, etc. Prerequisites: EE 3350 and EE 3355 and EE 4350, all with a grade of "C" or better, or permission of the instructor.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 4355. Analog and Mixed Signal Design.
Operational amplifier design applications, feedback, offset, stability, and compensation. Introduction to random signals and noise, discrete time circuitry analog-to-digital converters, and digital-to-analog converters. Prerequisites: EE 3370 and EE 4350, all with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.
Course Attribute(s): Lab Required
Grade Mode: Standard Letter

EE 4356. Power Electronics.
This course provides an introduction to power electronics and the use of such circuits for the control and conversion of electric power. Topics include semiconductor power devices and characteristics, DC-DC and multilevel converters, power inverters, and AC voltage controllers. Prerequisite: EE 4350 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 4357. Introduction to Microelectromechanical Systems.
This course will cover fabrication techniques for microelectromechanical devices and systems as well as provide an introduction to the design of micromechanical transducers. Co-requisite: MFGE 4392 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Course Attribute(s): Lab Required
Grade Mode: Standard Letter

EE 4358. Introduction to Digital Signal Processing.
Discrete systems, convolution, spectral analysis, and FIR and IIR filter design. Prerequisites: EE 3370 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Course Attribute(s): Lab Required
Grade Mode: Standard Letter

EE 4360. Linear Control Systems.
This course provides an introduction to linear continuous-time and discrete-time automatic control systems. Topics include time and frequency domain modeling and analysis, state variable analysis, feedback, transient and steady state response, stability, and sensitivity. Prerequisite: EE 3370 and MATH 3377, all with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 4367. Introduction to Wireless Communication.
In this course, students will learn the current 20th-century power grid structure and the key elements required to transform it to a 21st-century Smart Grid. Topics include two-way power/data flow to monitor, control, manage and integrate traditional bulk generation and bulk/renewable/distributed generation. Prerequisite: IE 3370 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

IE 3320.
EE 4378. Data Compression and Error Control Coding.  
Introduction to information theory, information content of messages, entropy and source coding, data compression, channel capacity data translation codes, and fundamentals of error correcting codes.  
Corequisite: EE 4370 with a grade of "C" or better.  
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.  
Course Attribute(s): Lab Required  
Grade Mode: Standard Letter

EE 4390. Electrical Engineering Design I.  
This course is a team-based design of a system or component, which will include oral presentations and written reports.  
Prerequisites: EE 3350 and EE 3370 and EE 3420, all with a grade of "C" or better.  
3 Credit Hours. 2 Lecture Contact Hours. 2 Lab Contact Hours.  
Course Attribute(s): Lab Required  
Grade Mode: Standard Letter

EE 4391. Electrical Engineering Design II.  
Advanced team-based design of a system or component, which will include oral presentations and written reports.  
(WI) Prerequisites: EE 4390 and EE 4352 or EE 4370, all with a grade of "C" or better.  
3 Credit Hours. 2 Lecture Contact Hours. 2 Lab Contact Hours.  
Course Attribute(s): Lab Required  
Grade Mode: Standard Letter

EE 4399A. Dynamic Data Acquisition and Analysis.  
Methods for acquiring and analyzing dynamic (time-varying) data.  
Frequency domain analysis, analog-to-digital conversion, windowing, and digital filtering taught in the context of various industrial applications.  
Prerequisite: EE 3370 Signals and Systems.  
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.  
Course Attribute(s): Exclude from 3-peat Processing|Topics  
Grade Mode: Standard Letter

EE 4399B. Overview of Information Theory and Coding.  
Fundamentals of Information Theory, Huffman coding, image encoding techniques, Hamming and BCH error control codes, Reed-Solomon coding, convolutional codes and the Viterbi decoding algorithm.  
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.  
Course Attribute(s): Exclude from 3-peat Processing|Topics  
Grade Mode: Standard Letter

Courses in Engineering (ENGR)  

An introductory communications course in the tools and techniques utilized to produce various types of working drawings.  
Principles of multiview projections, geometric relationships, shape and size description, and pictorial methods are included with emphasis on technical applications and design problem solving.  
3 Credit Hours. 2 Lecture Contact Hours. 2 Lab Contact Hours.  
Course Attribute(s): Lab Required  
Grade Mode: Standard Letter

ENGR 2300. Materials Engineering.  
Structure, properties and behavior of engineering materials including metals, polymers, composites and ceramics.  
Mechanical, electrical, magnetic, thermal, and optical properties are covered.  
Prerequisites: CHEM 1341 or CHEM 1335 and CHEM 1141, all with a grade of "D" or better.  
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.  
Grade Mode: Standard Letter

ENGR 3190. Cooperative Education.  
This course provides special problems in engineering for cooperative education students.  
Problems are related to the student's work assignment and culminate in a technical report.  
Three hours may be used as technical elective, and one additional hour may be used as free elective; 4 hours may be used toward graduation.  
Prerequisite: Overall GPA 2.5 or above and approval of department head.  
1 Credit Hour. 0 Lecture Contact Hours. 40 Lab Contact Hours.  
Course Attribute(s): Exclude from 3-peat Processing  
Grade Mode: Standard Letter

This course covers the principles of mechanic materials and includes the following topics: stress and strain; elastic modulus and Poisson’s ratio; constitutive equations; torsion; bending; axial, shear and bending moment diagrams; deflection of beams; and stability of columns.  
Prerequisite: ENGR 3375 with a grade of "D" or better.  
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.  
Course Attribute(s): Lab Required  
Grade Mode: Standard Letter

ENGR 3315. Engineering Economic Analysis.  
Interest formulas, economic equivalence, rate of return analysis, techniques of economic analysis for engineering decisions and an introduction to cost estimation.  
Prerequisite: MATH 1315.  
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.  
Grade Mode: Standard Letter

ENGR 3360. Structural Analysis.  
Structural engineering fundamentals to include design loads, reactions, force systems, functions of a structure, and the analysis of statically determinate and indeterminate structures by classical and modern techniques.  
Prerequisite: ENGR 3311 with a grade of "D" or better.  
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.  
Course Attribute(s): Lab Required  
Grade Mode: Standard Letter

ENGR 3373. Circuits and Devices.  
DC and AC circuit analysis, network theorems, electromechanical devices, electronic devices and an introduction to amplifiers, oscillators and operational amplifiers.  
Prerequisite: PHYS 2425 with a grade of "D" or better.  
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.  
Course Attribute(s): Lab Required  
Grade Mode: Standard Letter
ENGR 3375. Mechanics for Engineers.
This course covers statics, using a vector approach to mechanics. Prerequisite: PHYS 1430 with a grade of "D" or better. Co-requisite: MATH 2472 with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

ENGR 4390. Internship.
Supervised on-the-job professional learning experience in engineering and other technical areas. This course provides practical work experience in their particular field of interest.
3 Credit Hours. 0 Lecture Contact Hours. 20 Lab Contact Hours.
Grade Mode: Standard Letter

Open to undergraduate students on an independent basis by arrangement with the faculty member concerned. Requires school director's approval. Repeatable for credit with different emphasis. Prerequisite: junior or senior standing.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter

Courses in Industrial Engineering (IE)

IE 3310. Project Management for Engineers.
Basic principles governing the efficient and effective management of engineering projects. Topics include project planning, scheduling, and cost estimation procedures. Prerequisite: ENGR 3315 with a grade of "D" or better. (WI).
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Writing Intensive
Grade Mode: Standard Letter

Fundamentals of probability and statistical inference for engineering applications, probability distributions, parameter estimation, and hypothesis testing. Prerequisite: MATH 2472 with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Grade Mode: Standard Letter

IE 3330. Quality Engineering.
Quality assurance systems, quality costs, statistical quality control, and approaches for engineering quality into products and processes. Prerequisite: IE 3320.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

This course teaches models in operations research including linear programs, the simplex method, duality theory, sensitivity analysis, integer programs, and network flows. The emphasis is in learning to recognize, formulate, solve, and analyze practical industrial problems. The course also teaches commercial mathematical programming languages. Prerequisites: CS 1428 and MATH 3377 and ENGR 3315, all with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

IE 3350. Supply-Chain Engineering.
The analysis of supply chain problems to include facility location, customer assignment, vehicle routing, inventory management, and the role of information and decision support systems in supply chains. Prerequisite: IE 3340 with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

IE 3360. Methods Engineering and Ergonomics.
This course is a survey of methods for assessing and improving performance of individuals and groups in organizations. Techniques include various basic industrial engineering tools, work analysis, data acquisition and application, performance evaluation and appraisal, and work measurement procedures. Prerequisite: IE 3320 with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

IE 3370. Reliability Engineering.
Reliability of components and systems, reliability models, life testing, failure analysis, and maintainability. Prerequisite: IE 3320 with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

IE 3380. Optimization Techniques.
Mathematical modeling and computational methods for linear, integer, and nonlinear programming problems. Prerequisite: IE 3340 with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

IE 3390. Facilities Planning.
Planning, design, and analysis of facilities. Emphasizes the principles and methods used for solving plant layout, facility location, material handling, automation, computer integration, and warehouse operations. Prerequisite: ENGR 3315 and MFGE 2332.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter
IE 4360. Human Factors Design.
This course will emphasize the applications of human factors engineering to systems design. Prerequisites: IE 3360 with a grade of "D" or better. (WI).
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Course Attribute(s): Lab Required Writing Intensive
Grade Mode: Standard Letter

Probabilistic models in operations research to include queuing theory, simulation, and Markov chains. Emphasis will be placed on modeling applications to solve problems in industry and computing. Prerequisite(s): IE 3320 and CS 1428, all with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

IE 4380. Industrial Safety.
This course is a survey of occupational safety and hazards control. Topics include the history of occupational safety; hazard sources related to humans, environment, and machines; and engineering management of hazards.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Writing Intensive
Grade Mode: Standard Letter

IE 4390. Industrial Engineering Capstone Design.
Students form teams and apply industrial engineering principles to develop and implement solutions to industrial problems and/or systems engineering issues. Prerequisites: IE 3360, IE 4310, IE 4355, IE 4370 and MFGE 4396. Corequisites: IE 4320 and IE 4350.
3 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.
Grade Mode: Standard Letter

IE 4392. Industrial Engineering Design I.
Student teams apply engineering principles and standards under realistic constraints to develop solutions for industrial problems and/or systems engineering issues. This course is the first part of a two-course sequence and is followed by Industrial Engineering Design II (IE 4393). Prerequisite: IE 3330, IE 3340, and IE 3360. Corequisite: At least two of: IE 4310, IE 4355, and IE 4370.
3 Credit Hours. 2 Lecture Contact Hours. 2 Lab Contact Hours.
Course Attribute(s): Writing Intensive
Grade Mode: Standard Letter

IE 4393. Industrial Engineering Design II.
Student teams complete implementation of solutions to industrial problems and/or systems engineering issues with realistic constraints. This course is the second in a two-course sequence, and is continuation of Industrial Engineering Design I (IE 4392). Prerequisite: IE 4392, at least two of: IE 4310, IE 4355, or IE 4370. Corequisite: At least two of IE 4320, IE 4350, and MFGE 4396.
3 Credit Hours. 2 Lecture Contact Hours. 2 Lab Contact Hours.
Course Attribute(s): Writing Intensive
Grade Mode: Standard Letter

IE 4399A. Lean Six Sigma Methodologies.
This course covers the principles and methodologies of Six Sigma and Lean Manufacturing. Emphasis is on the tools and techniques used in Lean Six Sigma projects, including statistical process control, experimental design, project management and lean tools. Students will develop and complete a Lean Six Sigma project in industry. Prerequisite: IE 3330 and IE 4310.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing Topics
Grade Mode: Standard Letter

IE 4399D. Modern Heuristic Optimization Techniques.
Heuristic methods that search beyond local optima such as simulated annealing, tabu search, genetic algorithms, ant-colony systems, and particle swarm. Papers from the literature, problem-specific heuristics, evaluation methods and serial/parallel implementations are discussed. This course is an advanced undergraduate course for students in engineering and related fields. Prerequisites: IE 3340, CS 1428.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing Topics
Grade Mode: Standard Letter

IE 4399E. Introduction to Systems Engineering.
This course includes introductory topics in systems engineering and the systems-thinking process. The focus of the course is on the development of complex systems. Important topics include system understanding, modeling and design, the system development process, needs analysis, concept exploration and definition, design, integration and evaluation, and systems engineering management. Prerequisite: IE 3320 with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Course Attribute(s): Exclude from 3-peat Processing Topics
Grade Mode: Standard Letter

IE 4399F. Introduction to Data-Intensive Analysis and Simulation.
This course covers the foundational topics in data science and consists of three parts: The first part focuses on data extraction from databases, sensors and social media. The second part reviews data-intensive analysis through statistics and machine learning tools. The third part introduces the concept of farming data using design of experiments methodologies and computer simulation. Prerequisites: IE 3340 and IE 4310, all with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Course Attribute(s): Exclude from 3-peat Processing Topics
Grade Mode: Standard Letter

Courses in Manufacturing Engineering (MFGE)

MFGE 2132. Manufacturing Processes Lab.
Hands-on experience in variety of material removal processes such as turning, milling, drilling, and CNC machining; joining processes such as gas/arc welding, and soldering; metal casting, polymer and composite processing, and microelectronics manufacturing. Prerequisite or corequisite: MFGE 2332 with a grade of "D" or better.
1 Credit Hour. 0 Lecture Contact Hours. 2 Lab Contact Hours.
Grade Mode: Standard Letter
MFGE 2332. Material Selection and Manufacturing Processes.
Overview of material processing, material selection and process parameter determination. Processes covered include: material removal, forming, casting, polymer processing, semiconductor manufacturing and assembly processes. Laboratory activities provide opportunities for applying the design through manufacture activities of the product cycle. Prerequisite: ENGR 2300 with a grade of "D" or better. Corequisite: ENGR 2300.
3 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.

Topics include design process, description of wireframe/surface/solid models, transformation and manipulation of objects, finite element analysis, data exchange, process planning, machine elements, fundamentals of numerical control programming for turning and milling processes, fundamentals of CAD/CAM systems, CNC code generation by CAD/CAM software, waterjet, and plasma cutting. Prerequisites: ENGR 1313, ENGR 2300, and MFGE 2332.
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.

Grade Mode: Standard Letter

This course will cover the general procedures in designing various machine elements. These elements include shafts and flexible elements, springs, welded/riveted/brazed joints, screw fasteners, rolling/sliding contact bearings, gears, cams, and followers. Emphasis will be placed on using standard design practices. Prerequisite: ENGR 3311 or TECH 2351 with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

MFGE 4357. Dynamics of Machinery.
This course will cover kinematics and kinetics of particles; kinematics and kinetics of rigid bodies in two and three dimensions; application of dynamics to the analysis and design of machine and mechanical components; mechanical vibrations; linkages; gear trains; and balancing of machines. Prerequisite: MATH 3323 and ENGR 3375, all with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

Integrated design and development of products and processes; impact of ethical issues on design; the discussion of real-world engineering problems and emerging engineering issues with practicing engineers; preparation of reports; plans or specifications; cost estimation; project management, communication and the fabrication of an engineered product/system. Prerequisites: ENGR 3311 and MFGE 4365, all with a grade of "D" or better, and senior standing. Corequisite: IE 3330 with a grade of "D" or better. (WI).
3 Credit Hours. 2 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Lab Required/Writing Intensive
Grade Mode: Standard Letter

MFGE 4365. Tool Design.
Design of single and multi-point cutting tools, jig and fixture design, gage design, and the design of tooling for polymer processing and sheet metal fabrication. Laboratory projects will involve the use of computer aided design and rapid prototyping. Prerequisite: MFGE 3316 or ENGR 3316 or TECH 2310 with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.

Course Attribute(s): Lab Required
Grade Mode: Standard Letter

MFGE 4367. Polymer Properties and Processing.
Structure, physical & mechanical properties, design considerations and processing methods for polymer-based materials are presented. Processing methods include: injection molding, blow molding, thermoforming, compression molding, extrusion, filament winding, lay-up methods, vacuum bag molding and poltrusion. Prerequisite: MFGE 2332 or TECH 4362 with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.

Grade Mode: Standard Letter

MFGE 4376. Control Systems and Instrumentation.
The theory of automated control systems and its applications to manufacturing systems are covered in this course. Topics covered include: modeling of systems, time and frequency domain feedback control systems, stability analysis, transducer and sensor technology and digital control. Prerequisite: PHYS 1430; MFGE 2332 or TECH 4362 or EE 3370; ENGR 2300. Corequisite: MATH 3323.
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.

Grade Mode: Standard Letter

MFGE 4390. Manufacturing Engineering Design I.
This course is the first of a two course sequence involving integrated design and development of products and processes; impact of ethical issues on design; the discussion of real-world engineering problems and emerging engineering issues with practicing engineers; preparation of reports, plans and specifications; cost estimation; project management; and communication. Prerequisites: ENGR 3311 and MFGE 4365. Corequisite: IE 3330.
3 Credit Hours. 2 Lecture Contact Hours. 2 Lab Contact Hours.
Course Attribute(s): Writing Intensive
Grade Mode: Standard Letter

MFGE 4391. Manufacturing Engineering Design II.
This course is the second of a two course sequence involving implementation of Integrated design and development of products and processes; impact of ethical issues; the discussion of real-world engineering problems and emerging engineering issues with practicing engineers; preparation of reports, plans and specifications; cost estimation; project management; and communication. Prerequisites: IE 3330 and MFGE 4390.
3 Credit Hours. 2 Lecture Contact Hours. 2 Lab Contact Hours.
Course Attribute(s): Writing Intensive
Grade Mode: Standard Letter
MFGE 4392. Microelectronics Manufacturing I.
Provides an overview of integrated circuit fabrication including crystal growth, wafer preparation, epilaxial growth, oxidation, diffusion, ion-implantation, thin film deposition, lithography, etching, device and circuit formation, packaging and testing. The laboratory component involves production and testing of a functional semiconductor device. Prerequisites: CHEM 1141 and CHEM 1341, all with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Lab Required
Grade Mode: Standard Letter

MFGE 4394. Microelectronics Manufacturing II.
Topics include: atomic models for diffusion, oxidation and ion implantation; topics related to thin film processes i.e. CVD, PVD; planarization by chemical-mechanical polishing and rapid thermal processing; and process integration for bipolar and MOS device fabrication. Students will design processes and model them using a simulation. Prerequisite: MFGE 4392.
3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.
Grade Mode: Standard Letter

This course is an overview of computer integrated manufacturing is presented. Topics include control strategies for manufacturing systems, automated material handling systems, production planning, shop floor control, manufacturing execution systems, manufacturing databases and their integration, data communication and protocols and man/machine interfaces. Prerequisite: MFGE 3316 with a grade of "D" or better. (WI).
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Course Attribute(s): Lab Required|Writing Intensive
Grade Mode: Standard Letter

MFGE 4396. Manufacturing Systems Design.
Applications of simulation modeling to the design and analysis of manufacturing systems are presented in this course. Topics covered include queuing theory and discrete event simulation methods. Design projects will involve the use of current simulation language for modeling and analysis of manufacturing systems. Prerequisites: IE 3320. (WI).
3 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.
Course Attribute(s): Lab Required|Writing Intensive
Grade Mode: Standard Letter

MFGE 4399A. Reverse Engineering and Rapid Prototyping.
In the course 3D scanning technology for design, analysis, and inspection, is covered. Also, applications of the 3D scanning in reverse engineering and different rapid prototyping processes in a hands-on approach will be explained in this course.
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

MFGE 4399B. Introduction to Reinforced Polymer Nanocomposites in Industrial Applications.
Introductory course in reinforced polymer nanocomposites focusing on materials, manufacturing, characterization, and applications. Include, primarily nanoclay polymer matrix composites. Thrust will be the challenges in low-cost manufacturing for industrial applications, commercial successes, its impact on current material market, and future.
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

MFGE 4399C. Introduction to Industrial Robotics.
This course will cover the basic principles and techniques involved in industrial robotics. Emphasis will be placed on industrial robot applications, analysis of robot manipulators, components of industrial robots, robot programming and control. Prerequisite: MFGE 4376 with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter