

INGRAM SCHOOL OF ENGINEERING

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The Bachelor of Science (B.S.) degree with a major in Electrical Engineering provides students the background that is essential for the conception, design, development, and manufacture of electrical, electronic and information technology products and systems. Students may specialize in the areas of networks and communication systems, micro and nano devices and systems, or computer engineering. Proficiency in mathematics is especially important in Electrical Engineering. In order to be admitted to the EE program, a student needs to be qualified to take MATH 2417 or higher. The B.S. with a major in Electrical Engineering and the B.S. with a major in Electrical Engineering with Computer Engineering Concentration are both accredited by the Engineering Accreditation Commission of ABET (www.abet.org (<http://www.abet.org>)).

The B.S. major in Industrial Engineering provides students the background that is essential for improving the productivity, quality, safety, and cost effectiveness of all types of systems and processes. Industrial engineers are typically engaged in the areas of quality assurance, ergonomics, production and operations management, facilities design, work design, system optimization, information technology, and industrial safety. In order to be admitted to the IE program, a student needs to be qualified to take MATH 2417 or higher. The B.S. major in Industrial Engineering is accredited by the Engineering Accreditation Commission of ABET (www.abet.org (<http://www.abet.org>)).

The B.S. major in Manufacturing Engineering is designed to provide students with the mathematics, science, management, engineering, and applications skills needed to become manufacturing engineers. These engineers are typically responsible for promoting manufacturability, process planning, tool design, cost estimation, factory layout, work methods, quality assurance, automation, and systems integration. The degree has a concentration in general manufacturing or in mechanical systems. The B.S. major in Manufacturing Engineering is accredited by the Engineering Accreditation Commission of ABET (www.abet.org (<http://www.abet.org>)).

Annual student enrollment and graduation data is posted by the institution and is accessed through the website <http://www.engineering.txstate.edu/About/Data.html>.

The B.S. major in Civil engineering is designed to provide students with an education that addresses the emerging field of technology-enhanced (Smart) infrastructure as well as fundamental concepts in environmental, geotechnical, materials, structural, transportation, and water resources engineering. In addition to being capable of designing a range of infrastructure assets, graduates will have experience with sensor devices, data transmission and storage systems, big data and machine learning protocols, predicative modeling, and automated infrastructure management technologies. Further, students will be prepared to take the Fundamentals of Engineering and, later in their professional career. Principles and Practice of Engineering exams. The B.S. major in Civil engineering will seek accreditation in accordance with the process specified by the Engineering Accreditation Commission of ABET.

The Ingram School of Engineering Mission Statement

1. To provide students with an exceptional education in various disciplines of engineering,
2. To establish, through dedicated faculty, a nationally recognized research program, preparing interested students to achieve excellence in graduate studies and research, and
3. To serve the State of Texas and the nation by creating highly skilled, diverse, and motivated professionals capable of technological innovation and dedicated to the improvement of society.

The Ingram School of Engineering Vision Statement

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 engineering work.
2. Contribute to the solution of practical problems in industrial, service, and government organizations by applying skills acquired through continual 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:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. an ability to communicate effectively with a range of audiences.
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and social contexts.
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusions.
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

(A) a knowledge of probability, statics, and mathematics through differential and integral calculus, differential equations, linear algebra, complex variables, and discrete mathematics.

(B) 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.

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 student population

of strong diversity, the program attempts to be a significant provider of an global workforce.

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 continual learning to sustain technical currency and excellence throughout one's career. Promote the profession and its benefits to society.

Each graduate is expected to have:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
8. An ability to design, develop, implement, and improve integrated systems that include people, materials, equipment and energy, and to accomplish the integration of systems using appropriate analytical, computational, and experimental practices.

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, optimize/implement, and evaluate 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.
5. Practice coninutal learning.

Each graduate is expected to have:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

The Civil Engineering Mission Statement, Program Educational Objectives, and Student Outcomes

Our mission is:

To provide a rigorous, practical, interdisciplinary education within a diverse environment and focused on the design, monitoring, and management of technology-enhanced infrastructure. Graduates shall be uniquely prepared to succeed in professional employment, continuing education, and industry leadership for the benefit of Texas, the nation, and the world beyond.

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

1. Graduates shall enter into civil engineering practice, graduate studies, or another professional career.
2. Graduates shall contribute to the implementation of SMART and Internet of Things (IoT) technology in their professional work.
3. Graduates shall communicate professionally and effectively in technical and non-technical settings.

4. Graduates shall maintain high standards of professional and ethical responsibility.
5. Graduates shall advance professionally through graduate and continuing education opportunities.
6. Graduates shall serve as leaders in the community and within the profession.
7. Graduates shall become licensed Professional Engineers.

Each graduate is expected to have:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

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:

Code	Title	Hours
MATH 1315	College Algebra	3
MATH 1317	Plane Trigonometry	3
MATH 1319	Mathematics for Business and Economics I	3
MATH 1329	Mathematics for Business and Economics II	3

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.

Code	Title	Hours
MATH 1315	College Algebra	3
MATH 1317	Plane Trigonometry	3
MATH 1319	Mathematics for Business and Economics I	3
MATH 1329	Mathematics for Business and Economics II	3

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:

Code	Title	Hours
MATH 1315	College Algebra	3
MATH 1317	Plane Trigonometry	3
MATH 1319	Mathematics for Business and Economics I	3
MATH 1329	Mathematics for Business and Economics II	3

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:

Code	Title	Hours
MATH 1315	College Algebra	3
MATH 1317	Plane Trigonometry	3
MATH 1319	Mathematics for Business and Economics I	3
MATH 1329	Mathematics for Business and Economics II	3

Bachelor of Science (B.S.)

- Major in Civil Engineering (<http://mycatalog.txstate.edu/undergraduate/science-engineering/ingram-school/civil-engineering-bs>)
- 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: CE, EE (p. 4), ENGR (p. 9), IE (p. 9), MFGE (p. 11)

Courses in Civil Engineering (CE)

CE 1210. Introduction to Smart Infrastructure.

This course is an overarching study of municipal and private infrastructure and the use of modern technology and techniques to monitor and manage these assets. Topics and case studies examine transportation, water resources, utilities, and other construction projects. General topics related to the civil engineering profession are also covered.

2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CE 2340. Infrastructure Materials.

This course examines the composition, production, engineering properties, and in-place behavior of materials used to construct and repair infrastructure assets. Sensing devices used to monitor a material are discussed. Students will learn to follow standard test methods, perform data acquisition, conduct data analysis, and visualize test data. Prerequisite: CHEM 1335 and ENGR 3311 both with grades of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.
Grade Mode: Standard Letter

CE 2350. Structural Analysis.

This course is an introduction to the loading, response, analysis, and monitoring of infrastructure assets. Determinate and indeterminate structures are studied. Analysis by classic and modern computational methods are covered. The analysis of data obtained from sensing devices in, on, or remote to an infrastructure asset is discussed. Prerequisite: ENGR 3311 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

CE 3310. Applications in Smart Infrastructure.

This course presents students with realistic civil engineering scenarios involving various infrastructure assets. Students work in teams using commercially available monitoring devices and programmable single-board microcontrollers to gather, transmit, and analyze measured data with the objective of developing a solution for each individual project. Prerequisite: CE 1210 and CS 1342 and ENGR 3373 all with grades of "C" or better.

3 Credit Hours. 2 Lecture Contact Hours. 2 Lab Contact Hours.
Grade Mode: Standard Letter

CE 3320. Environmental Engineering.

This course is an introduction to environmental engineering. Topics include treatment of water, wastewater, air pollution, solid waste pollution, and hazardous materials. Standard test procedures for evaluating physical, chemical, and biological treatment processes are introduced. The use of technology to manage treatment processes and facilities will be introduced. Prerequisite: CHEM 1335 and [(BIO 1130 and BIO 1330) or (BIO 1131 and BIO 1331) or GEOL 1410] all with grades of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.
Grade Mode: Standard Letter

CE 3330. Soil Mechanics.

This course examines the engineering characteristics of soil. Topics include identification, compaction, shear strength, consolidation, vertical stress, and deformation. Standard laboratory test methods are followed. Advanced data analysis, interpretation, and visualization techniques are presented. Prerequisite: ENGR 3311 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.

Grade Mode: Standard Letter

CE 3331. Infrastructure Foundations.

This course investigates foundation systems which support infrastructure assets. Shallow and deep foundations, piles, footings, mats, and retaining walls may be covered. Foundations are evaluated for consolidation, rate of settlement, stress distribution, elastic settlement, and bearing capacity. Life-cycle management of foundations will be examined. Prerequisite: CE 3330 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

CE 3350. Design of Reinforced Concrete Infrastructure.

This course covers the analysis and design of reinforced concrete infrastructure assets. Topics include columns, beams, one-way slabs, and footings. Students will learn how to read, interpret, and use specifications and design codes. The use of technology to monitor the behavior of a reinforced concrete infrastructure asset will be introduced. Prerequisite: CE 2340 and CE 2350 both with grades of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

CE 3360. Transportation Planning and Infrastructure.

This course is an introduction to the planning and design of transportation infrastructure assets. Social, economic, safety, and engineering issues impacting transportation are examined. Interactions between users, vehicles, and the infrastructure will be addressed. The expanding use of technology to enhance transportation systems will be examined. Prerequisite: IE 3320 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.

Grade Mode: Standard Letter

CE 4310. Infrastructure Sensor Technologies.

This course is an advanced study of the sensor technologies available to monitor the performance and behavior of infrastructure assets. Prerequisite: CE 3310 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

CE 4311. Communication Systems for Smart Infrastructure.

This course examines the issues and processes involved in the transmission of data between sensor devices and data storage centers. Topics include data communication principles, transmission signals, wireless and wired communication systems, security, and examples of best practices. Prerequisite: ENGR 3373 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

CE 4320. Biological Wastewater Management.

This course examines biological treatment processes for domestic and industrial wastewater. The use of sensor technologies to monitor the effectiveness of a treatment option is also addressed. Prerequisite: CE 3320 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

CE 4321. Hazardous Waste Management.

This course is a study of best management practices relative to hazardous waste. Topics include contamination processes, site investigations, detection, analysis methods, evaluation methods, and risk management, and treatment protocols. The use of technology to manage the life-cycle performance of contaminated hazardous wastes sites will be studied. Prerequisite: CE 3320 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

CE 4322. Air Pollution Management.

This course is an introductory study of air pollution. Topics include sources, quality, meteorological influences, atmospheric dispersion modeling, and control methods. The use of sensor technologies to monitor the effectiveness of an air pollution control option is also addressed. Prerequisite: CE 3320 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

CE 4330. Design of Retaining Structures.

This course examines the design of geotechnical structures, such as a retaining wall, that retain soil or another material. The use of technology to manage the life-cycle performance of retaining structures will be studied. Prerequisite: CE 3331 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

CE 4350. Design of Prestressed Concrete Infrastructure.

This course covers the analysis and design of prestressed concrete infrastructure assets. Topics include columns, beams, slabs, pipes, and piles. Students will learn how to read, interpret, and use specifications and design codes. The use of technology to monitor the behavior of a prestressed concrete infrastructure asset will be introduced. Prerequisite: CE 3350 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

CE 4351. Design of Steel Infrastructure.

This course covers the analysis and design of steel infrastructure assets. Topics include connections, columns, beams, and beam-columns. Students will learn how to read, interpret, and use specifications and design codes. The use of technology to analyze the behavior of steel infrastructure assets will be introduced. Prerequisite: CE 2350 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

CE 4360. Intelligent Transportation Systems.

This course is a study of the components, technologies, and infrastructure assets that comprise intelligent transportation systems (ITS). Smart technologies, data acquisition, and communication sub-systems will be examined within the context of personal, commercial, and public transportation. Coverage will include mobility, public safety, socio-economic and environmental factors impacting transportation systems. Prerequisite: CE 3310 and CE 3360 both with grades of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

CE 4361. Highway Engineering.

This course covers alignment, interchange, construction, and maintenance issues related to highways. Topics include cross-sections, horizontal and vertical alignment, sight distance, pavement design, drainage analysis, traffic engineering, highway capacity, and construction materials. The analysis of data obtained from sensing devices during construction or use of a highway is also discussed. Prerequisite: CE 3360 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

CE 4370. Hydraulics.

This course is an examination of the properties, distribution, and circulation of water. Topics include pipe flow, pipe networks, pumps, and open channel flow. The use of sensors to monitor fluid flow, pressure, and leaks will be addressed. Advanced data analysis and visualization techniques will be presented. Prerequisite: ENGR 3380 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.

Grade Mode: Standard Letter

CE 4371. Hydrology.

This course is an examination of surface and groundwater hydrology. Topics include the hydrologic cycle, groundwater flow, wells, storm water management practices, open channel flow, stream flow measurements, hydrologic routing, modeling, probability, and applications. The use of sensors to monitor hydrologic activity is also addressed. Prerequisite: CE 4370 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.

Grade Mode: Standard Letter

CE 4372. Water and Wastewater Treatment.

This course is a study of the physical, chemical, and biological processes used to clean water and wastewater. The use of sensors to monitor treatment processes is also addressed. Prerequisite: CE 4370 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.

Grade Mode: Standard Letter

CE 4390. Civil Engineering Design I.

This is the first in a two-course sequence meant to prepare students for engineering practice with a culminating major design experience. This course covers the planning, scheduling, budgeting, and management aspects of a technology-enhanced infrastructure design project. Prerequisite: CE 3310 and CE 3330 and CE 3350 and CE 3360 all with grades of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Course Attribute(s): Writing Intensive

Grade Mode: Standard Letter

CE 4391. Civil Engineering Design II.

This is the second in a two-course sequence meant to prepare students for engineering practice with a culminating major design experience. This course focuses on the completion of all phases of the design project. Prerequisite: CE 3320 and CE 4390 both with grades of "C" or better. Corequisite: CE 3331 and CE 4370 and GEO 4356 all with grades of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Course Attribute(s): Writing Intensive

Grade Mode: Standard Letter

CE 4392. Sustainable Infrastructure.

This course examines the sustainability characteristics of various infrastructure assets. The assets and characteristics examined will be established by the course instructor. Examples include pervious pavements, sustainable construction materials, and sustainability in the design process. The use of technology to manage the life-cycle performance of an asset will be studied. Prerequisite: CE 3331, CE 3350, CE 3360, and CE 3380 all with grades of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

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.

4 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.

Grade Mode: Standard Letter

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.

Course Attribute(s): Lab Required

Grade Mode: Standard Letter

EE 3326. Numerical and Scientific Data Analysis Using Python.

This course introduces Python programming for engineers. Topics include basics of Python programming, introduction to numerical Python (NumPy), scientific programming using Python (SciPy), data visualization using Matplotlib, data processing using Pandas and introduction to Object Oriented Programming using Python. Prerequisite: CS 1342 or CS 1428 either with a grade of "D" or better.

3 Credit Hours. 2 Lecture Contact Hours. 2 Lab Contact Hours.

Grade Mode: Standard Letter

EE 3340. Electromagnetics.

Topics in this course include wave propagation, Maxwell's equations, transmission lines, wave guides, and antennas. Prerequisite: EE 3400 and MATH 3373 and PHYS 2425 and PHYS 2435 all with grades of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

EE 3350. Electronics I.

Analysis and design of active device equivalent circuits with emphasis on transistors, switching circuits, and operational amplifiers. Prerequisites: EE 3400 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.

Course Attribute(s): Lab Required

Grade Mode: Standard Letter

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. Prerequisite: EE 3400 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 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. Prerequisite: EE 3400 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

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 both with grades of "C" or better.

4 Credit Hours. 3 Lecture Contact Hours. 2 Lab Contact Hours.

Grade Mode: Standard Letter

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.

Course Attribute(s): Writing Intensive

Grade Mode: Standard Letter

EE 4321. Digital Systems Design Using HDL.

This course will cover the design of digital systems using HDL including implementation of custom microprocessor and peripheral architectures. Prerequisite: EE 3420 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

EE 4323. 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 both with grades of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

EE 4350. Electronics II.

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.

Course Attribute(s): Lab Required

Grade Mode: Standard Letter

EE 4351. 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 with a grade of "C" or better and a minimum 2.25 Overall GPA. Corequisite: EE 3355 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.

Grade Mode: Standard Letter

EE 4352. Introduction to VLSI Design.

Analysis of design of CMOS integrated circuits. Introduction to CAD tools for VLSI design. Prerequisites: EE 3350 and [CS 2420 or EE 2420] both 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

EE 4353. Fundamentals of Advanced Semiconductor Technology.

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.

Grade Mode: Standard Letter

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 grades of "C" or better or instructor approval.

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 both with grades 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 4358. 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 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 both with grades of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

EE 4370. Communication Systems.

Transmission of signals through linear systems, analog and digital modulation, filtering, and noise. Prerequisites: EE 3370 and IE 3320 both with grades of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.

Course Attribute(s): Lab Required

Grade Mode: Standard Letter

EE 4372. Communication Networks.

Data communication concepts, protocols, algorithms, 7-layer OSI model, physical media, LAN architecture and components, Ethernet, FDDI, TCP/IP, and related standards. Prerequisite: EE 2400 and EE 3420 both 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

EE 4374. Introduction to Wireless Communication.

Principles, practice, and system overview of mobile systems. Modulation, demodulation, coding, encoding, and multiple access techniques. Prerequisites: EE 4370 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 4375. Building a Smart Grid Architecture.

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: EE 3370 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

EE 4376. Introduction to Telecommunications.

Fundamentals of telecommunications, telephone networks, switching and transmission systems, circuit and packet switching, cell processing, and queuing theory and applications. Co-requisite: EE 4370 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 4377. 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 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. Co-requisites: EE 4352 or EE 4370. (WI).

3 Credit Hours. 2 Lecture Contact Hours. 2 Lab Contact Hours.

Course Attribute(s): Lab Required|Writing Intensive

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 with a grade of "C" or better. Corequisite: EE 4352 or EE 4370 either with a grade of "C" or better.

3 Credit Hours. 2 Lecture Contact Hours. 2 Lab Contact Hours.

Course Attribute(s): Lab Required|Writing Intensive

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 with a grade of "D" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

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. Prerequisite: EE 3370 with a grade of "D" or better.

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)

ENGR 1313. Engineering Design Graphics.

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. Prerequisite: CHEM 1141 and [CHEM 1335 or CHEM 1341] both with grades 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 an industrial supervisor's evaluation and technical report or presentation. The course may be repeated up to 3 times, and 2 to 3 credits apply towards a program elective. Prerequisite: Minimum 2.25 Overall GPA.

1 Credit Hour. 0 Lecture Contact Hours. 40 Lab Contact Hours.

Course Attribute(s): Exclude from 3-peat Processing

Grade Mode: Standard Letter

ENGR 3311. Mechanics of Materials.

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 or MATH 2417 or MATH 2471 any with a grade of "D" or better.

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. Corequisite: MATH 2472 or MATH 2473 either with a grade of "D" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

ENGR 3380. Fluid Mechanics.

This course is an introduction to fluid motion. Fluid flow, pressure, energy, and momentum are examined. Dimensional analysis is also covered. Sensing devices used to monitor a fluid are discussed. Students will learn to follow standard laboratory procedures, perform data acquisition, conduct data analysis, and visualize test data. Prerequisite: ENGR 3375 and MATH 3323 both with grades of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 2 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

ENGR 4395. Independent Studies in Engineering.

Open to undergraduate students on an independent basis by arrangement with the faculty member concerned.

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

IE 3320. Engineering Statistics.

Fundamentals of probability and statistical inference for engineering applications, probability distributions, parameter estimation, and hypothesis testing. Prerequisite: MATH 2472 or MATH 2473 either 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 with a grade of "D" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

IE 3340. Operations Research.

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.

Prerequisite: CS 1428 and ENGR 3315 and MATH 3377 all with grades 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 4310. Statistical Design of Experiments.

Statistically designed experiments for engineering applications. Topics include analysis of variance, randomized complete designs, factorial designs, empirical models generated from controlled experiments, and response surfaces. 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 4320. Integrated Production Systems.

Basic concepts in the design and control of integrated production systems to include forecasting, inventory models, material requirements planning, scheduling, planning, and shop floor control. 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 4330. 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 4340. 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 4350. 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 4355. 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 both with grades of "D" or better.

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

IE 4370. Probabilistic Operations Research.

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: CS 1428 and IE 3320 both with grades of "D" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

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 3310 and IE 3330 and 6 hours from [IE 3360 or IE 4310 or IE 4355 or IE 4370 or MFGE 4396] all with grades of "D" or better. Corequisites: IE 4320 and IE 4350 both with grades of "D" or better.

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 and IE 3340 and IE 3360 all with grades of "D" or better. Corequisite: 6 hours from [IE 4310 or IE 4355 or IE 4370] both with grades of "D" or better.

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 the second in a two-course sequence, and is continuation of Industrial Engineering Design I (IE 4392). Prerequisite: IE 4392 and 6 hours from [IE 4310 or IE 4355 or IE 4370] all with grades of "D" or better. Corequisite: 6 hours from [IE 4320 or IE 4350 or MFGE 4396] both with grades of "D" or better.

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 both with grades of "D" or better.

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. Prerequisite: CS 1428 and IE 3340 both with grades of "D" or better.

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 both with grades 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. 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. Corequisite: ENGR 2300 with a grade of "D" or better.

3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.

Grade Mode: Standard Letter

MFGE 3316. Computer Aided Design and Manufacturing.

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 and ENGR 2300 and MFGE 2332 all with grades of "D" or better.

3 Credit Hours. 3 Lecture Contact Hours. 1 Lab Contact Hour.

Grade Mode: Standard Letter

MFGE 4355. Design of Machine Elements.

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 either 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; premechanical vibrations; linkages; gear trains; and balancing of machines. Prerequisite: ENGR 3375 and MATH 3323 both with grades of "D" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

MFGE 4363. Concurrent Process Engineering.

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. (WI) Prerequisites: ENGR 3311 and MFGE 4365 both with grades of "D" or better. Corequisites: IE 3330 with a grade of "D" or better.

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 TECH 2310 either 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 either 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: ENGR 2300 and PHYS 1430 and [EE 3370 or MFGE 2332 or TECH 4362] all with grades of "D" or better. Corequisite: MATH 3323 with a grade of "D" or better.

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 both with grades of "D" or better. Corequisite: IE 3330 with a grade of "D" or better.

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 both with grades of "D" or better.

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, epitaxial 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 both with grades 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 with a grade of "D" or better.

3 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.

Grade Mode: Standard Letter

MFGE 4395. Computer Integrated Manufacturing.

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. (WI) Prerequisite: IE 3320 with a grade of "D" or better.

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