

INGRAM SCHOOL OF ENGINEERING

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The Bachelor of Science (B.S.) degree with a 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 (www.abet.org (<https://www.abet.org/>)).

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. 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 Bachelor of Science (B.S.) degree with a major in Industrial Engineering provides students the background that is essential for improving the productivity, quality, safety, sustainability, and cost effectiveness of all types of systems and processes. Industrial engineers are typically engaged in the areas of quality control, ergonomics, facilities design, work design, production and operations management, supply chain design, information technology, system optimization, and industrial safety. The B.S. major in Industrial Engineering is accredited by the Engineering Accreditation Commission of ABET (www.abet.org (<https://www.abet.org/>)).

The Bachelor of Science (B.S.) degree with a major in Manufacturing Engineering is designed to provide students with the mathematics, science, management, engineering, and applications skills needed to become manufacturing engineers. Manufacturing engineering is a broad area that includes the design and development of products, emphasizing their manufacturability. This engineering discipline involves researching and developing the tools, processes, machines, and equipment required for manufacturing. It also includes integrating facilities and systems to produce high-quality products using the most cost-effective manufacturing methods. The degree has a concentration in general manufacturing or mechanical systems. The B.S. major in Manufacturing Engineering is accredited by the Engineering Accreditation Commission of ABET (www.abet.org (<https://www.abet.org/>)).

The Bachelor of Science (B.S.) degree with a major in Mechanical Engineering is designed to provide students with an education that

combines a strong foundation in traditional mechanical engineering principles with a unique education in designing and developing mechanical products and systems that are intelligent, interconnected, and integrated with the virtual world and emerging digital infrastructure. The curriculum will prepare students to apply principles of engineering, basic science, and mathematics to model, analyze, design, and realize thermal and mechanical physical systems, components, or processes. In addition, students will have the necessary background to use modern tools and technologies such as engineering simulation, rapid prototyping, additive manufacturing, sensor systems, robotics, real-time communication, big data and analytics. The B.S. major in Mechanical Engineering will seek accreditation in accordance with the process specified by the Engineering Accreditation Commission of ABET (www.abet.org (<https://www.abet.org/>)).

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.

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/>)
- Major in Mechanical Engineering (<http://mycatalog.txstate.edu/undergraduate/science-engineering/ingram-school/mechanical-bs/>)

Subjects in this school include:

CE, EE (p. 2), ENGR (p. 8), IE (p. 9), ME (p. 12), MFG (p. 14)

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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

CE 3310. Applications in Smart Infrastructure.

This course presents students with realistic civil engineering scenarios involving various infrastructure assets. The course is taught in a combination of classroom lectures and lab hands-on projects. With concepts learned in lectures, students work in teams on state of the art smart infrastructure sensor technologies 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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

CE 4100. Civil Engineering Undergraduate Research.

Undergraduate students investigate a special topic in civil engineering by developing a research idea, conducting a literature review, researching the topic, and presenting the findings. Research plans will be developed on an individual basis with strict faculty supervision.

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

Course Attribute(s): Exclude from 3-peat Processing|Dif Tui- Science & Engineering

Grade Mode: Standard Letter

CE 4200. Civil Engineering Undergraduate Research.

Undergraduate students investigate a special topic in civil engineering by developing a research idea, conducting a literature review, researching the topic, and presenting the findings. Research plans will be developed on an individual basis with strict faculty supervision.

1 Credit Hour. 0 Lecture Contact Hours. 6 Lab Contact Hours.

Course Attribute(s): Exclude from 3-peat Processing|Dif Tui- Science & Engineering

Grade Mode: Standard Letter

CE 4300. Civil Engineering Undergraduate Research.

Undergraduate students investigate a special topic in civil engineering by developing a research idea, conducting a literature review, researching the topic, and presenting the findings. Research plans will be developed on an individual basis with strict faculty supervision.

1 Credit Hour. 0 Lecture Contact Hours. 9 Lab Contact Hours.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

CE 4323. Physical and Chemical Treatment of Water.

This course is a study of the physical and chemical processes used to clean water and wastewater. The use of sensors to monitor treatment processes is also addressed. Prerequisite: CE 3320 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 2 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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

CE 4362. Traffic Engineering.

This course is a basic introduction of the components of a highway traffic system and fundamentals of traffic engineering; analysis of traffic stream characteristics, levels of service, and capacity of urban and rural highways; study of warrants for traffic control devices; design and analysis of traffic signals and timing plans; analysis of urban and highway traffic characteristics using simulation software. Prerequisite: CE 3360 with a grade of 'C' or better.

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

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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): Dif Tui- Science & Engineering|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): Dif Tui- Science & Engineering|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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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. Corequisite: CS 1428 with a grade of "C" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering|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 "C" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering

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 2393 and PHYS 2425 and PHYS 2435 all with grades of "C" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering

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. 2 Lab Contact Hours.

Course Attribute(s): Dif Tui- Science & Engineering|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 and PHYS 2425 both with grades of "C" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering|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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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): Dif Tui- Science & Engineering|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.

Course Attribute(s): Dif Tui- Science & Engineering

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. Prerequisite: EE 3370 and EE 3420 both with grades of "C" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

EE 4331. Introduction to Machine Learning for Engineering Applications.

This course covers an introduction to machine learning focused on deep learning techniques using engineering applications with Python. Topics include model characteristics, neural network theory, classifiers for network and signal processing applications, regression and convolutional modeling for object-detection, time-series and forecasting machine learning models for Smart City concepts. Prerequisite: CS 1428 or CS 1342 with a grade of "C" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

EE 4332. Introduction to Computer-Aided Engineering Simulation on HPC Systems.

This course covers the introductory development of simulations for engineering applications that are solved using High-Performance Computing environments. Topics include programming techniques for multicore processors, processor and memory architecture, computation for dense and sparse linear algebra applications, computational temperature analysis, fluid dynamics, stencil, stochastic algorithms, and other applications. Prerequisite: CS 1428 with a grade of "C" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering

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. 2 Lab Contact Hours.

Course Attribute(s): Dif Tui- Science & Engineering|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. 2 Lab Contact Hours.

Course Attribute(s): Dif Tui- Science & Engineering

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): Dif Tui- Science & Engineering|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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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): Dif Tui- Science & Engineering|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.

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

EE 4357. Introduction to Power Systems.

This course provides an introduction to analysis of various elements of power systems, including power generation, transformer action, transmission line modeling, symmetrical components, power factor correction, real and quadrature power calculations, load flow analysis, and economic considerations in operating systems. Prerequisite: EE 3350 with a grade of "C" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering

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): Dif Tui- Science & Engineering|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.

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

EE 4370. Communication Systems.

This course covers 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. 2 Lab Contact Hours.

Course Attribute(s): Dif Tui- Science & Engineering|Lab Required

Grade Mode: Standard Letter

EE 4372. Communication Networks.

This course covers data communication concepts, protocols, algorithms, 7-layer OSI model, physical media, LAN architecture and components, Ethernet, TCP/IP, and related standards. Prerequisite: EE 3420 with a grade of "C" or better. Corequisite: EE 3370 with a grade of "C" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering|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): Dif Tui- Science & Engineering|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.

Course Attribute(s): Dif Tui- Science & Engineering

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): Dif Tui- Science & Engineering|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): Dif Tui- Science & Engineering|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): Dif Tui- Science & Engineering|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. (WI) Prerequisites: EE 3420 and EE 3350 and EE 3370 and IE 3320 all with grades of "C" or better. Corequisites: EE 4352 or EE 4356 or EE 4360 or EE 4370 any with a grade of "C" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering|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): Dif Tui- Science & Engineering|Lab Required|Writing Intensive

Grade Mode: Standard Letter

EE 4392. Microelectronics Manufacturing I.

This course provides an overview of integrated circuit fabrication. This includes 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. Prerequisite: CHEM 1341 or CHEM 1335 either with a grade of "C" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

EE 4394. Microelectronics Manufacturing II.

Topics include atomic models for diffusion, oxidation and ion implantation; topics related to thin film processes, e.g. CVD and 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: EE 4392 or MFGE 4392 either with a grade of "C" or better.

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

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 "C" or better.

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

Course Attribute(s): Exclude from 3-peat Processing|Dif Tui- Science & Engineering|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 "C" or better.

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

Course Attribute(s): Exclude from 3-peat Processing|Dif Tui- Science & Engineering|Topics

Grade Mode: Standard Letter

EE 4399I. Fundamentals of Sound Systems Engineering.

This course provides an introduction to sound systems engineering and its fundamental principles applied in developing audio and sound systems for various industries. This course will develop a theoretical and practical understanding of the fundamentals of sound engineering, including acoustics, audio components, sound processing, and test & measurement. Prerequisite: EE 2420 and EE 3350 and EE 3370 and PHYS 2425 all with grades of "C" or better.

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

Course Attribute(s): Exclude from 3-peat Processing|Dif Tui- Science & Engineering|Topics

Grade Mode: Standard Letter

Courses in Engineering (ENGR)

ENGR 1304. Engineering Graphics.

This course covers the introduction to computer-aided drafting using CAD software and sketching to generate two- and three-dimensional drawings based on the conventions of engineering graphical communication 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): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

TCCN: ENGR 1304

ENGR 2300. Materials Engineering.

Course topics include structure, properties and behavior of engineering materials including metals, polymers, composites and ceramics. Mechanical, electrical, magnetic, thermal, and optical properties are covered. Prerequisites: [CHEM 1135 or 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.

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

ENGR 2301. Statics.

This course covers the theory of engineering mechanics. Topics include forces, moments, and couples acting on stationary engineering structures. Additionally, two and three dimensional equilibrium, free-body diagrams, friction, centroids, and centers of gravity are covered.

Prerequisite: PHYS 1430 with a grade of "C" or better. Corequisite:

MATH 2472 or MATH 2473 either with a grade of "C" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

TCCN: ENGR 2301

ENGR 2302. Dynamics.

This course introduces the fundamentals of kinematics and kinetics of individual particles, systems of particles, and rigid bodies. Topics include the rectilinear, curvilinear, and general motion, Newton's laws of motion, work and energy relationship, principles of impulse and momentum, and application of kinetics and kinematics to the solution of engineering problems. Prerequisite: ENGR 2301 and MATH 2472 both with grades of "C" or better.

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

Grade Mode: Standard Letter

TCCN: ENGR 2302

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|Dif Tui- Science & Engineering

Grade Mode: Standard Letter

ENGR 3290. Advanced Cooperative Education.

This course provides advanced 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. This course may be taken up to two times for a maximum of 4 credits applied towards advanced engineering electives. Prerequisite: A minimum 2.25 Overall GPA; ENGR 3190 with a grade of "D" or better.

2 Credit Hours. 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 the mechanics of 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 or ENGR 2301 with a grade of "D" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering|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.

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

ENGR 3373. Circuits and Devices.

Topics include circuit analysis and network theorems with emphasis on applications of analog and digital electronic devices, transducers, sensors, and electromechanical devices. Prerequisite: PHYS 2425 and [CS 1428 or CS 1342] both with grades of "D" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering|Lab Required

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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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|Dif Tui- Science & Engineering

Grade Mode: Standard Letter

Courses in Industrial Engineering (IE)

IE 3305. Introduction to Data Analysis.

This course introduces principles and applications of data analysis using Microsoft Excel, Access, VBA, and machine learning. Students will utilize these applications to develop solutions to challenging industrial engineering problems. Emphasis will be placed on computing productivity in a spreadsheet-based setting to develop practical, useful decision support applications to facilitate engineering decisions. Corequisite: IE 3320 with a grade of "C" or better.

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

Grade Mode: Standard Letter

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): Dif Tui- Science & Engineering|Writing Intensive

Grade Mode: Standard Letter

IE 3320. Engineering Statistics.

This course covers the fundamentals of probability and statistics, including probability distributions, visualization techniques of large-scale datasets, hypothesis testing, and regression modeling. The students will be exposed to traditional engineering applications of statistical modeling, as well as those modern problems encountered in big data analysis.

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

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

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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 or CS 1342] and ENGR 3315 and MATH 3377 all with grades of "D" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

IE 4335. Lean Six Sigma Methodologies.

This course covers the principles and methodologies of Six Sigma and Lean. Emphasis is on the tools and techniques used in Lean Six Sigma projects, including statistical process control, experimental design, project management and Lean tools. Prerequisite: IE 3330 and IE 4310 both with grades of "C" 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.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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 MFG 2332 both with grades of "D" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering

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): Dif Tui- Science & Engineering|Lab Required|Writing Intensive

Grade Mode: Standard Letter

IE 4370. Probabilistic Operations Research.

This course describes 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 or CS 1342] and IE 3320 with grades of "D" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

IE 4381. Introduction to Systems Engineering.

This course is an introduction to the systems thinking process, systems of systems, and the fundamental considerations associated with the engineering of large-scale systems, or systems engineering. These topics include the system development process, needs analysis, concept exploration, concept definition, engineering 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. 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 MFG 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.

Course Attribute(s): Dif Tui- Science & Engineering

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): Dif Tui- Science & Engineering|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 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 MFG 4396] both with grades of "D" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering|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|Dif Tui- Science & Engineering|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|Dif Tui- Science & Engineering|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|Dif Tui- Science & Engineering|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|Dif Tui- Science & Engineering|Topics

Grade Mode: Standard Letter

Courses in Mechanical Engineering (ME)

ME 1101. Introduction to Digital Mechanical Engineering Lab.

This lab course introduces students to engineering labs and digital equipment. Topics include instruction in design labs, a brief introduction to computer-aided design (CAD), and digital additive manufacturing and making. Corequisite: ENGR 1304 and ME 1201 both with grades of "C" or better.

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

Grade Mode: Standard Letter

ME 1201. Introduction to Digital Mechanical Engineering.

This course introduces students to mechanical engineering as a discipline and a profession. Topics include instruction in the engineering design process, use of digital sensors, AI, the Internet of Things and the security of sensors in mechanical systems, engineering simulation and application of mathematical and scientific principles to solve practical problems, ethics, and career opportunities.

2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.

Grade Mode: Standard Letter

ME 3151. Smart Instrumentation and Measurement Lab.

In this lab course, students conduct Internet of Things concept experiments for mechanical measurements using digital instrumentation and transducers via wireless digital communication and computer-based data acquisition tools. Lab experiments cover fundamental experimental techniques, operational principles of various digital instruments and transducers, and statistical data analysis techniques. Prerequisite: ENGR 3373 with a grade of "C" or better. Corequisite: ME 3351 with a grade of "C" or better.

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

Grade Mode: Standard Letter

ME 3161. Computer Aided Design and Digital Manufacturing Lab.

In this lab, students get hands-on experience in reading CAD drawing standards, lab safety, machine tools operation, welding, as well as operation of digital manufacturing processes including 2D and 3D CNC machining, additive manufacturing, laser cutting, plastics and composites manufacturing, and waterjet cutting. Prerequisite: ME 1101 or MFGE 2332 either with a grade of "C" or better. Corequisite: ME 3361 or MFGE 3316 either with a grade of "C" or better.

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

Grade Mode: Standard Letter

ME 3311. Mechanics of Solids.

This course covers advanced topics in solid mechanics including combined loadings, statically indeterminate loadings, thermal stresses, unsymmetrical bending, stress concentrations, inelastic deformations, stress and strain transformations, plane stress, plane strain, Mohr's circle, failure criteria, curved beams, and torsion of prismatic bars. Prerequisite: ENGR 3311 with a grade of "C" or better.

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

Grade Mode: Standard Letter

ME 3330. Engineering Thermodynamics.

This course covers introductory concepts of thermodynamics, energy transfer and general energy analysis, properties of pure substances, ideal gas model, mass and energy analysis of control volumes, first and second laws of thermodynamics, entropy, power cycles, and refrigeration cycles. Prerequisite: CHEM 1135 and CHEM 1335 and MATH 2472 all with grades of "C" or better.

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

Grade Mode: Standard Letter

ME 3331. Heat Transfer.

This course covers introductory concepts of heat transfer, steady-state and transient conduction in one- and two-dimensions, external forced convection, internal forced convection, natural convection, heat exchangers, and fundamentals of radiation. Prerequisite: ME 3335 and MATH 3323 both with grades of "C" or better.

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

Grade Mode: Standard Letter

ME 3335. Engineering Fluid Mechanics.

This course covers introduction to fluid mechanics, fluid properties, fluid statics, fluid dynamics, control volume analysis, differential analysis of fluid flow, dimensional analysis, viscous flow in pipes, external flows, and open channel flows. Prerequisite: ENGR 2302 and MATH 2393 and ME 3330 all with grades of "C" or better.

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

Grade Mode: Standard Letter

ME 3351. Smart Instrumentation and Measurement.

This course covers basic concepts and principles of instrumentation and measurement systems, analog and digital devices, basic electronics, sensors and transducers, introduction to the Internet of Things (IoT) and big data, cybersecurity of IoT devices, wireless digital network and communication, probability and statistics to characterize measurement uncertainty, data acquisition and analysis using software packages, and measurements of physical properties such as temperature, pressure, and strain. Prerequisite: ENGR 3373 with a grade of "C" or better. Corequisite: ME 3151 with a grade of "C" or better.

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

Grade Mode: Standard Letter

ME 3361. Computer Aided Design And Digital Manufacturing.

This course provides an in-depth study of Computer Aided Design (CAD) and Digital Manufacturing. Topics include design process, mathematical and graphical demonstration of wireframe/surface/solid models, transformation and manipulation of objects, CAD file formats and data exchange, process planning, cutting tools types and materials, milling process, fundamental of CNC machines, numerical control programming for milling processes, CNC code generation and simulation by CAD/CAM software, and an overview of other digital manufacturing processes such as additive manufacturing, laser cutting and welding, and waterjet cutting. Prerequisite: ENGR 1304 and ENGR 2300 and ME 1101 all with grades of "C" or better. Corequisite: MATH 2471 and ME 3161 both 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

ME 4131. Fluids/Thermal Lab.

This laboratory course is designed for students to conduct experiments based on various principles of fluid mechanics, thermodynamics, and heat transfer. Students need to use proper experimental methods and interpret data using these principles and uncertainty analysis. Prerequisite: ME 3151 and ME 3331 and ME 3351 all with grades of "C" or better. Corequisite: ME 4390 with a grade of "C" or better.

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

ME 4311. Mechanical Vibrations.

This course introduces fundamental concepts on the vibration of mechanical systems. Topics include equations of motion, free and forced vibrations of damped/undamped single- and multi-degree-of-freedom mechanical systems, self-excitation and stability analysis, application of transfer functions for vibration problems, Lagrange's equations, and determination of natural frequencies and mode shapes of multi-degree-of-freedom systems. Prerequisite: ENGR 2302 and MATH 3376 and MATH 3323 all with grades of "C" or better.

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

ME 4312. Mechanics of Composite Materials.

This course focuses on the elastic properties of a wide range of composites including unidirectional and multidirectional laminates, particulate/fiber-reinforced composites; invariant properties of an orthotropic lamina; classical lamination theory; strength of laminates; and use of general purpose computer codes for classical laminate theory. Prerequisite: MATH 3376 and ME 3311 and MFGE 4355 all with a "C" or better.

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

ME 4332. Modern Heating, Ventilating, and Air Conditioning.

This course focuses on current and upcoming practices in heating, ventilating, and air conditioning (HVAC), including psychometrics, standards, ventilation requirements, load estimates, filtration, air sterilization, and building energy system design, simulation, and control. Prerequisite: ME 3331 with a grade of "C" or better.

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

ME 4341. Computational Fluid Dynamics.

This course introduces the scientific principles and practical engineering applications of Computational Fluid Dynamics (CFD). Although it provides a brief overview of the fundamental mathematics governing fluid flow and heat transfer phenomena, its emphasis is to apply the knowledge using commercial CFD software. Topics include set-up of appropriate CFD parameters, conduct of steady-state and transient fluid flow simulations, solutions for both isothermal and non-isothermal thermo-fluid applications, solutions for both incompressible and compressible fluid flow applications, solutions for fluid flow through porous media and rotating machinery, and extraction of the required results including plots. Prerequisite: MATH 3323 and MATH 3376 and ME 3335 all with grades of "C" or better.

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

ME 4351. Control Systems.

This course covers introductory concepts of linear control systems. Topics include mathematical modeling of physical systems, Laplace transform, transfer function, modeling and analysis in state space, transient and steady state responses, root locus and stability, control systems in time and frequency domains, Bode plot, and design of PID controllers. Prerequisite: ENGR 2302 and MATH 3323 both with grades of "C" or better.

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

ME 4355. Autonomous Systems and Robotics.

This course introduces different types of autonomous systems, such as autonomous driving vehicles, drones, and robots, and provides an introduction to the methods and algorithms used in design, construction, and operation of such systems. The emphasis is on the application of autonomous systems, their components, and their underlying control algorithms, including sensor fusion, real-time decision making and learning, information processing, path planning, localization, and intelligent control. Prerequisite: ENGR 2302 and IE 3320 and MATH 3376 and ME 4351 all with grades of "C" or better.

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

ME 4390. Mechanical 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 indicating use of appropriate engineering standards and multiple constraints, plans and specifications; cost estimation; project management; and communication. Prerequisite: ME 3331 and MFGE 4355 both with grades of "C" or better. Corequisite: ME 4131 with a grade of "C" or better.

3 Credit Hours. 2 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Writing Intensive
Grade Mode: Standard Letter

ME 4391. Mechanical 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 indicating use of appropriate engineering standards and multiple constraints, plans and specifications; cost estimation; project management; and communication. Prerequisite: ME 4131 and ME 4390 both with grades of "C" or better.

3 Credit Hours. 2 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Writing Intensive
Grade Mode: Standard Letter

Courses in Manufacturing Engineering (MFGE)

MFGE 2132. Manufacturing Lab 1: Manufacturing Process and Digital Engineering.

In this lab, students get hands-on experience in reading CAD drawing standards, lab safety, machine tools operation, welding, plastics and composites manufacturing, mechanical testing, and the use of Excel spreadsheets and functions in solving practical problems. Corequisite: MFGE 2332 with a grade of "D" or better.

1 Credit Hour. 0 Lecture Contact Hours. 2 Lab Contact Hours.

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

MFGE 3116. Manufacturing Lab 2: Computer Aided Design and Manufacturing.

In this lab, student conduct hands-on experiments on digital manufacturing processes including 2D and 3D CNC machining, additive manufacturing, laser cutting, and waterjet cutting. Corequisite: MFGE 3316 with a grade of "D" or better.

1 Credit Hour. 0 Lecture Contact Hours. 2 Lab Contact Hours.

Course Attribute(s): Dif Tui- Science & Engineering

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. Corequisites: MATH 2471 with a grade of "D" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

MFGE 4176. Manufacturing Lab 3: Intelligent Robotics and Control.

In this lab, students conducting hands-on experiments on intelligent robotics, control system and instrumentation including industrial robot applications, PLC control systems, PID control systems, sensors and devices Prerequisite: ENGR 3373 with a grade of "D" or better. Corequisite: MFGE 4376 with a grade of "D" or better.

1 Credit Hour. 0 Lecture Contact Hours. 2 Lab Contact Hours.

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

MFGE 4315. Energy and Thermofluids Engineering.

This course covers core engineering concepts of energy and thermofluids based on fluid mechanics, thermodynamics, and heat transfer. The main topics include properties of pure substances, fluid statics and dynamics, differential analysis of fluid flow, viscous flow in pipes, external flows, open channel flows, mass and energy analysis of control volumes, first and second laws of thermodynamics, steady-state and transient conduction, internal and external forced convection, natural convection, and fundamentals of radiation. Prerequisite: MATH 3323 and PHYS 2425 both with grades of "D" or better.

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

Grade Mode: Standard Letter

MFGE 4318. Additive Manufacturing.

In this course CAD standards, development of additive manufacturing technology, photopolymerization, powder bed fusion, extrusion-based systems, printing processes, sheet lamination processes, beam deposition processes, design for additive manufacturing, and safety considerations in a hands-on approach will be explained. The concept learned from this course will help students manage large systems or complex infrastructures in a more efficient and sustainable way. Prerequisite: Instructor approval.

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

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

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: [ENGR 2301 or ENGR 3375] and MATH 3323 both with grades of "D" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering

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): Dif Tui- Science & Engineering|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): Dif Tui- Science & Engineering|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 or ME 3361 any with a grade of "D" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering

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.

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

MFGE 4377. Introduction to Polymer Nanocomposites.

This course introduces reinforced polymer nanocomposites, focusing on materials, manufacturing, characterization, and applications. Topics include primarily nanoclay polymer matrix composites. The course will emphasize challenges in low-cost manufacturing for industrial applications, commercial successes, and impact on current and future materials market. Prerequisite: Instructor approval.

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

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

MFGE 4378. 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): Dif Tui- Science & Engineering

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. 3 Lab Contact Hours.

Course Attribute(s): Dif Tui- Science & Engineering|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. 3 Lab Contact Hours.

Course Attribute(s): Dif Tui- Science & Engineering|Writing Intensive

Grade Mode: Standard Letter

MFGE 4392. Microelectronics Manufacturing I.

This course 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 1341 or CHEM 1335 either with a grade of "C" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering|Lab Required

Grade Mode: Standard Letter

MFGE 4394. Microelectronics Manufacturing II.

This course covers topics including 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: EE 4392 or MFGE 4392 either with a grade of "C" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering

Grade Mode: Standard Letter

MFGE 4395. Computer Integrated Manufacturing.

This course is an overview of computer integrated manufacturing in the digital world. Topics include control strategies for advanced manufacturing, automated testing, distributed manufacturing, automated material handling systems, manufacturing databases and their integration, and man/machine interfaces. (WI) Prerequisites: MFGE 3316 and [CS 1428 or CS 1342] with grades of "D" or better.

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

Course Attribute(s): Dif Tui- Science & Engineering|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): Dif Tui- Science & Engineering|Lab Required|Writing Intensive

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|Dif Tui- Science & Engineering|Topics

Grade Mode: Standard Letter