

MANUFACTURING ENGINEERING (MFGE)

MFGE 241, INTRODUCTION TO MECHATRONICS, 3 Credits

Explores the fundamentals of mechatronics: electronic circuits, tools, and basic sensors/actuators commonly used in the manufacturing process monitoring. Examines the operation and use of these instruments and tools for mechatronics design and prototyping. Examines the fundamentals of five types of sensors: distance, movement, proximity, stress/strain, and temperature, with a focus on the mathematical modeling of the sensors when they are embedded in a mechanical system. Apply basic programming in LabVIEW software to support the operation of data sampling through a data acquisition card. Integrate mechanical design with electronics controlled by a computer in an open loop fashion in the lab.

Prerequisite: ENGR 202 with C or better

MFGE 285, INTRODUCTION TO INDUSTRIAL AND MANUFACTURING ENGINEERING, 3 Credits

Introduction to selected topics in industrial and manufacturing engineering, including history and philosophy, product design and manufacturing cycle, integrate role of engineering and business, and multi-objective nature of organizations. Surveys of selected design problems in resource allocation, operations and quality management, and production engineering. CROSSLISTED as IE 285/MFGE 285.

Prerequisite: IE 112 (may be taken concurrently) with C or better or FOR 112 (may be taken concurrently) with C or better

Equivalent to: IE 285

MFGE 336, PRODUCTION ENGINEERING, 4 Credits

Provides a general understanding of the production engineering function within industry and the means by which to achieve tight tolerances through machining. Geometric dimensioning and tolerancing, fixture and gage design, and fundamentals of metal cutting mechanics are introduced, and their interactions are explored. Lec/lab.

Prerequisite: (ENGR 213 with C or better or ENGR 213H with C or better) and ENGR 248 [C] and (ENGR 321 [C] or ENGR 321H [C] or MATS 321 [C] or MATS 321H [C]) and ME 250 [C]

Equivalent to: IE 336

MFGE 337, MATERIALS AND MANUFACTURING PROCESSES, 4 Credits

Introduces mechanical manufacturing methods by which materials are economically shaped into valuable products. The overall goal is to develop an understanding of how the functionality, shape, materials, cost and sustainability of a product influence manufacturing process selection and design. Lec/lab.

Prerequisite: ((ENGR 321 with C or better or ENGR 321H with C or better or MATS 321 with C or better or MATS 321H with C or better) and ME 250 [C] and MFGE 336 [C])

Equivalent to: IE 337

MFGE 341, LOGICAL CONTROL FOR MECHATRONICS SYSTEMS, 4 Credits

Explore embedded software and hardware infrastructures used in mechatronics systems. Examine binary number and Boolean algebra using AND, OR, and XOR operators in microcontroller-controlled systems, and flip-flops and other basic components that realize binary control functions. Explore the working principles of AVR microcontroller systems, including the internal structure of clock timers, memory space, and IO addresses. Implement basic microcontroller operations using Assembly language. Demonstrate functions such as open loop control and wired/wireless communication in labs by programming a commercial microcontroller platform with assembly language.

Prerequisite: MFGE 241 with C or better

MFGE 413, COMPUTER AIDED DESIGN AND MANUFACTURING, 4 Credits

Introduces students to the application of computer aided engineering tools across the extended product design and manufacturing cycle. Students become familiar with new product development and working in a sustaining engineering environment with an emphasis on using computer-aided design (CAD) and computer-aided manufacturing (CAM) tools to gain competitive advantage.

Prerequisite: ENGR 248 with C or better and (IE 366 [C] or ME 382 [C] or ME 382H [C])

Equivalent to: ME 413

MFGE 436, LEAN MANUFACTURING SYSTEMS ENGINEERING, 4 Credits

The planning, evaluation, deployment, and integration of lean manufacturing theory and methods. Examines manufacturing processes/equipment and systems, e.g., planning/control, product design, supply chain resource management. Lec/lab.

Prerequisite: ENGR 390 with C or better or ENGR 391 with C or better

Equivalent to: IE 436

MFGE 437, COMPUTER CONTROL OF MANUFACTURING PROCESSES, 4 Credits

Introduces fundamental knowledge in the automation of manufacturing systems and processes. Automated manufacturing system design and operations—computer numerical control (CNC) technology; NC part programming; sensors and actuators, their modeling and dynamic simulation; feedback motion delivery systems design and tuning; programmable logic controls (PLC) for industrial control systems, and path planning for numerical controlled (NC) machinery. Lec/lab.

Prerequisite: (ME 317 with C or better or ME 317H with C or better or MFGE 336 with C or better) and (ENGR 212 [C] or ENGR 212H [C])

Equivalent to: IE 437

MFGE 438, COMPOSITES MANUFACTURING, 4 Credits

Introduction to fiber-reinforced composite materials and their applications. Topics include matrices and reinforcement; open and closed molding processes; filament winding, quality, testing, damage assessment; basics of factory operations and sustainability of composites. Students will complete laboratory projects using fiber-reinforced laminates. Lec/lab.

Prerequisite: ENGR 213 with C or better or ENGR 213H with C or better

MFGE 441, DIGITAL CONTROL OF MECHATRONICS SYSTEMS, 4 Credits

Explores modeling and control of mechatronics systems. Review Laplace and Fourier transforms and then examine Industrial Proportional (P), Derivative (D), Integral (I)-based, PD, P-PI, PID, lead-lag and pole placement feedback control strategies, and their design principles based on time and frequency domain performance metrics. Explores the frequency domain loop-shaping control design approach, and reference command generation and feedforward control for motion control. Examines digital control and real-time implementation of feedback control laws on real-time micro-processor systems. Implement and test feedback control algorithms on a servo motor setup in the labs.

Prerequisite: ENGR 212 with C or better and MFGE 341 [C]

MFGE 442, ADVANCED SIGNAL PROCESSING FOR MECHATRONICS SYSTEMS, 4 Credits

Examine continuous and discrete Fourier Transforms, and Fast Fourier Transform algorithm concepts. Explore the design of low, high and band-pass filtering based on Finite (FIR) and Infinite (IIR) Impulse Response filters, and 1D and 2D image signal processing basics. Apply Artificial Neural Network (ANN) Basics for pattern recognition, regression and classification. Implement digital filtering on micro-processor systems, and apply ANN for image processing in the labs.

Prerequisite: MFGE 441 with C or better

MFGE 499, SPECIAL TOPICS, 0-5 Credits

This course is repeatable for 99 credits.

MFGE 507, SEMINAR, 1-16 Credits

Graded P/N.

This course is repeatable for 16 credits.

MFGE 511, PRECISION MACHINE DESIGN, 3 Credits

Tolerance analysis and application in design/manufacturing practice, principles of machine design and computational analysis of errors in machine design, sensor mounting and sensor calibration, machine level error budget with geometric and thermal errors, structural design of joints and supports, deterministic damping, exact constraint design for flexures and couplings, bearing systems design, motion and power system design for machine tools. CROSSLISTED as ME 511/MFGE 511.

Equivalent to: ME 511

Recommended: An understanding of mechanical component design and solid mechanics.

MFGE 525, COMPUTATIONAL METHODS FOR ADVANCED MANUFACTURING, 3 Credits

Identifies different schemes of computational modeling and constructs the necessary math basics required for each scheme. Determines the appropriate scheme(s) for various types of manufacturing processes. Analyzes thermomechanical conditions of manufacturing processes; in order to make sure that: first the modeled process is sound from thermomechanical point of view and second, the product is able to function as desired. Applies commercial or open source software suites to use the covered methods and schemes to solve a wide variety of engineering and manufacturing problems. Identifies the strength and limitations of the models used and interpret the results.

Recommended: ME 316 or mechanics of materials course; MFGE285 or manufacturing course; ME 373, ME 424 or numerical analysis or FEA course

MFGE 531, MICROMANUFACTURING, 4 Credits

Introduction to microsystem platforms, scaling laws and size effects in micromanufacturing techniques with an emphasis on microchannel arrays, microchannel lamination and micro-scale characterization. Lec/lab.

Equivalent to: IE 531

MFGE 535, INDUSTRIAL SUSTAINABILITY ANALYSIS, 3 Credits

Students are exposed to the role of business and engineering in the design and implementation of sustainable industrial systems. Drivers, metrics, and analysis concepts, methods, and tools are introduced. Students incorporate business and engineering considerations in making product, manufacturing process, and supply chain design considerations.

MFGE 536, LEAN MANUFACTURING SYSTEMS ENGINEERING, 4 Credits

The planning, evaluation, deployment, and integration of lean manufacturing theory and methods. Examines manufacturing processes/equipment and systems, e.g., planning/control, product design, supply chain resource management. Lec/lab.

Equivalent to: IE 536

Available via Ecampus

MFGE 538, COMPOSITES MANUFACTURING, 4 Credits

Introduction to fiber-reinforced composite materials and their applications. Topics include matrices and reinforcement; open and closed molding processes; filament winding, quality, testing, damage assessment; basics of factory operations and sustainability of composites. Students will complete laboratory projects using fiber-reinforced laminates. Lec/lab.

Recommended: (ENGR 213 or ENGR 213H)

MFGE 551, ADDITIVE MANUFACTURING, 3 Credits

Introduces basic principles and process physics for additive manufacturing as compared with subtractive manufacturing. Various processes in AM (extrusion, jetting, photopolymerization, powder bed fusion, direct energy deposition and sheet lamination) and laser AM are discussed. Materials selection in AM (metals, polymers, ceramics and composites), powder metallurgy and metallurgical phenomena in additive manufacturing will be covered.

MFGE 599, SPECIAL TOPICS, 0-5 Credits

This course is repeatable for 99 credits.