MECHANICAL ENGINEERING (M E)

M E 1 – COOPERATIVE EDUCATION PROGRAM
1 credit.

Work experience which combines classroom theory with practical knowledge of operations to provide students with a background upon which to base a professional career in industry.
Requisites: Sophomore standing
Course Designation: Workplace - Workplace Experience Course
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

M E 151 – INTRODUCTION TO MECHANICAL ENGINEERING
2 credits.

Introduction to the field of Mechanical Engineering through problem-solving in the context of small group projects. Fabricate, build, and test prototypes. Introduction to computer software of particular relevance to Mechanical Engineers.
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2017

M E 160 – ARCHITECTURAL GRAPHICS
3 credits.

The skill of communicating through the graphic media of freehand and instrumental drawing. Architectural presentation, isometric, perspective and shades and shadows.
Requisites: None
Repeatable for Credit: No
Last Taught: Fall 2018

M E 201 – INTRODUCTION TO MECHANICAL ENGINEERING
3 credits.

Provides an introduction to the field of Mechanical Engineering in the context of a major, semester-long project that is carried out in small groups as well as several, smaller hands-on projects. Obtain a shop pass, design build and test small prototypes using the shop as well as 3-D printing, take measurements using various instruments, and use a microcontroller to control a system. Introduction to software that is particularly useful to Mechanical Engineers including SolidWorks and EES. Learn how to design experiments, obtain data, use data to develop simple models of systems, exercise models for the purposes of design, and present their results professionally. It will provide a context for the math, physics and chemistry classes that are taken during the first year of the Mechanical Engineering curriculum and also provide a preview of future ME courses and should also give you a glimpse into the breadth of opportunities afforded by a mechanical engineering degree.
Requisites: Declared in Biomedical, Biological Systems, Chemical, Civil, Computer, Electrical, Environmental, Geological, Industrial, Mechanical, or Nuclear Engineering, Materials Science and Engineering, Engineering Physics, or Engineering Mechanics
Repeatable for Credit: No
Last Taught: Spring 2024

M E 231 – GEOMETRIC MODELING FOR DESIGN AND MANUFACTURING
3 credits.

Introduction to basic methods and fundamental concepts in geometric description and modeling of mechanical form, components, and assemblies. Topics include elements of descriptive geometry, engineering drawing standards, introduction to computer modeling, and geometric dimensioning and tolerancing (GDT). Lectures are reinforced by the laboratory experience where students operate modern commercial computer-aided design systems to model and to learn the basics of engineering communication, specification, and annotation.
Requisites: Declared in Biomedical, Biological Systems, Chemical, Civil, Computer, Electrical, Environmental, Geological, Industrial, Mechanical or Nuclear Engineering, Mat Sci and Engin, Engin Physics, Engineering Mechanics or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2024

M E 240 – DYNAMICS
3 credits.

Rectilinear and curvilinear motion of a particle; force, mass, acceleration; work, potential, and kinetic energy; impulse and momentum; kinematics of rigid bodies; moving coordinate systems with relative motion; general planar rigid body kinematics and kinetics. Applications to linkages, cams and geared systems.
Requisites: E M A 201 and (MATH 222 or 276), or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2024

M E 273 – ENGINEERING PROBLEM SOLVING WITH EES
1 credit.

This course will serve the dual purpose of providing students with a high level of proficiency in the Engineering Equation Solver software as well as giving students the opportunity to solve high-level engineering problems using this tool. Students leaving the course will have a very solid understanding of equation solving software including advanced features that would not be covered in any other class on campus. Students will also get another opportunity to apply sophisticated computing tools to engineering applications.
Requisites: MATH 222 or 276, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2023

M E 291 – UNDERGRADUATE MECHANICAL ENGINEERING PROJECTS
1-3 credits.

Individual lab projects under staff supervision.
Requisites: Consent of instructor
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2023

M E 299 – INDEPENDENT STUDY
1-3 credits.

Directed study projects as arranged with instructor.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2023

M E 306 – MECHANICS OF MATERIALS
3 credits.

Stress and strain, torsion, bending of beams, shearing stresses in beams, compound stresses, principal stresses, deflections of beams, statically indeterminate members, columns.
Requisites: E M A 201 and (MATH 222 or 276), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2024

M E/E M A 307 – MECHANICS OF MATERIALS LAB
1 credit.

Data processing, tension/compression tests, creep stress concentrations, fatigue, fracture, composite materials, combined stress, beam flexure, dynamic loads, buckling.
Requisites: (M E 306, E M A 303 or concurrent enrollment) or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2024

M E 310 – MANUFACTURING: POLYMER PROCESSING AND ENGINEERING
3 credits.

Introduction to all important aspects of polymer processing and engineering including polymeric materials, material properties, design and manufacturing considerations, processing methods, part performance, post-consumer recycling and upcycling, societal responsibilities and ethics, and various techniques for modeling in materials processing like dimensional analysis, design of experiments, analytical solutions, and computer simulation.
Requisites: (M E 306 or E M A 303) and M E 231
Repeatable for Credit: No
Last Taught: Spring 2024

M E 311 – MANUFACTURING: METALS AND AUTOMATION
3 credits.

An introduction to processes for manufacturing metal parts, designing parts to make them easier to manufacture with these methods, and approaches for increasing productivity. Manufacturing automation, control, and metrology for increased safety, productivity, and part quality. Engineering economics for determining the cost of manufacturing a part.
Requisites: (M S & E 350, 351, or 352 or declared in Biological Systems Engineering: Machinery Systems BS), M E 231, and (M E 306 or E M A 303)
Repeatable for Credit: No
Last Taught: Spring 2024

M E 313 – MANUFACTURING PROCESSES
3 credits.

A quantitative and qualitative study of manufacturing processes including machining, extrusion, sheet metal forming, welding, and casting for metals; and additive manufacturing, extrusion, injection molding, thermoforming and blow molding for plastics. Emphasis on process selection for optimum design. Laboratory experiments and demonstrations. Quality, strength, and economic evaluations.
Requisites: (M S & E 350, 351, or 352) or (declared in Biological Systems Engineering: Machinery Systems, BS and M E 306 or E M A 303)
Repeatable for Credit: No
Last Taught: Spring 2021

M E 314 – MANUFACTURING FUNDAMENTALS
3 credits.

An introduction to techniques for modeling in materials processing and improving decision making in increasing the productivity of design and manufacturing processes. Quality improvement and engineering simulation tools are presented as well as the methods of engineering economy and the role of manufacturing automation and systems, through lectures and laboratories.
Requisites: M E 313 and (M E 340 or concurrent enrollment)
Repeatable for Credit: No
Last Taught: Fall 2022

M E 331 – COMPUTER-AIDED ENGINEERING
3 credits.

Introduction to the fundamentals of Computer Aided Engineering. Topics include mathematical and programmable methods for modeling and design of mechanical shapes and assemblies; shape processing for manufacturing, including NC machining and 3D printing; and computer-aided analysis of structural, thermal and other physical properties.
Requisites: M E 231, (MATH 320, 340, 341, or 375), (M E 306 or E M A 303 or concurrent enrollment), (M E 240 or E M A 202), and (COMP SCI 200, 220, 300, 301, 310, or placement into COMP SCI 300), or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2024

M E 340 – DYNAMIC SYSTEMS
3 credits.

Mathematical modeling and analysis of dynamic systems with mechanical, thermal, and fluid elements. Topics: time domain solutions, analog computer simulation, linearization techniques, block diagram representation, numerical methods and frequency domain solutions. Students are assumed to have basic competence in particle and planar rigid body dynamics, matrix and vector algebra, and linear differential equations.
Requisites: (M E 240 or E M A 202) and (MATH 319, 320, or 375), or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2024

M E 342 – DESIGN OF MACHINE ELEMENTS
3 credits.

Analysis and design of machine elements and machines; loads, stresses, deflections, material selection, fatigue failure, finite elements; mechanical power transmission components including gearing, bearings, shafting, and frictional devices.
Requisites: (M E 306 or E M A 303) and (M E 331, B M E 201, or concurrent enrollment or declared in Biological Systems Engineering), or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2024

M E 346 – INTRODUCTION TO FEEDBACK CONTROL FOR MECHANICAL ENGINEERS
3 credits.

Overview of linear feedback control analysis and design techniques for mechanical systems. Modeling of linear dynamic mechanical systems (review), derivation of their defining differential equations, and analysis of their response using both transient and frequency response techniques; Analysis and design of feedback control of mechanical systems using classical control transform techniques such as root locus and frequency response; Analysis of system robustness through evaluation of phase and gain margins and the Nyquist stability criterion. Design domains, including mechanical, thermal, and fluid feedback control systems. Effects of non-ideal system characteristics commonly encountered in mechanical systems, such as compliance, delay, and actuator and sensor saturation.
Requisites: M E 340, E M A 545, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2023

M E 349 – ENGINEERING DESIGN PROJECTS
3 credits.

Applied engineering design projects. Emphasis on design of practical mechanical engineering systems, devices and/or components. Two 2-hr labs and one lecture per week. Lecture focuses on the design process, creativity, patents, and other applications to practical problems.
Requisites: Declared in Mechanical Engineering with senior standing and M E 331
Repeatable for Credit: No
Last Taught: Spring 2020

M E 351 – INTERDISCIPLINARY EXPERIENTIAL DESIGN PROJECTS I
3 credits.

First of a two-course sequence (M E 351 and 352) in which students design and fabricate systems and devices, typically having an interdisciplinary aspect. In the first course, emphasis will be on project planning, team dynamics, problem identification, and conceptual design and evaluation.
Requisites: Declared in Mechanical Engineering with senior standing and M E 331
Repeatable for Credit: No
Last Taught: Spring 2024

M E 352 – INTERDISCIPLINARY EXPERIENTIAL DESIGN PROJECTS II
3 credits.

Design and fabricate systems and devices, typically having an interdisciplinary aspect. Emphasis will be on detailed design, fabrication, testing, and modification of concepts developed in the previous course (M E 351).
Requisites: Senior standing and M E 351
Repeatable for Credit: No
Last Taught: Spring 2024

M E 361 – THERMODYNAMICS
3 credits.

First and second laws of thermodynamics; thermodynamic properties of gases, vapors, and gas-vapor mixtures; energy-systems analysis including power cycles, refrigeration cycles and air-conditioning processes. Introduction to thermodynamics of reacting mixtures.
Requisites: (CHEM 103 or 109) and E M A 201, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2024

M E 363 – FLUID DYNAMICS
3 credits.

Laws of mechanics and thermodynamics applied to fluids at rest and in motion; potential flow; dimensional analysis; viscous flow; pipe flow; boundary-layer theory; compressible flow.
Requisites: M E 361 and (MATH 319, 320 or 375), or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2024

M E 364 – ELEMENTARY HEAT TRANSFER
3 credits.

Fundamental concepts of conduction, convection, radiation. Heat-exchanger principles.
Requisites: M E 361 and (M E 363 or concurrent enrollment), or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2024

M E 368 – ENGINEERING MEASUREMENTS AND INSTRUMENTATION
4 credits.

Theory of modern instrumentation, the design and execution of experiments and the analysis of experimental data. Laboratory provides direct experience with concepts in the context of experimental design for hypothesis testing, for product evaluation and for control system design.
Requisites: (M E 306 or E M A 303), M E 361, 340, and (E C E 376, 230, or M E 376)
Repeatable for Credit: No
Last Taught: Spring 2024

M E 370 – ENERGY SYSTEMS LABORATORY
3 credits.

Experimental evaluation and analysis of performance of various energy conversion systems such as turbines, compressors, refrigerators, fans, and internal combustion engines.
Requisites: M E 363 and (M E 364 or concurrent enrollment) and (M E 368 or concurrent enrollment)
Repeatable for Credit: No
Last Taught: Spring 2024

M E 376 – INTRODUCTION TO MECHATRONICS
4 credits.

Fundamentals of DC and AC circuit analysis and design, stressing tools needed to understand circuits typically used in instrumentation and control of physical systems (sensors/actuators); an introduction to the design of active and passive linear circuits for buffering and filtering signals; an introduction to digital circuits, Boolean logic, programming, especially as needed for computer interface operations in mechanical engineering applications (example: embedded microcontrollers). Laboratory exercises.
Requisites: (M E 340 or concurrent enrollment), (MATH 320, 319, or 376), and (PHYSICS 202, 208, or 248), or graduate/professional standing
Repeatable for Credit: No
Last Taught: Spring 2024

M E/B M E 414 – ORTHOPAEDIC BIOMECHANICS - DESIGN OF ORTHOPAEDIC IMPLANTS
3 credits.

Apply the design process for orthopaedic implants (total joint replacements). Topics include: library skills; joint anatomy; tissue properties; surgical approach; joint loading; implants materials; preclinical testing and analysis.
Requisites: Senior standing and (M E 306 or E M A 303), or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E/B M E 415 – BIOMECHANICS OF HUMAN MOVEMENT
3 credits.

An overview of experimental and modeling techniques used to study human movement. Specific topics will include locomotion, motion capture systems, force plates, muscle mechanics, musculoskeletal modeling, three dimensional kinematics, inverse dynamics, forward dynamic simulation and imaging based biomechanics. Homework and laboratory activities emphasize applications of movement biomechanics in orthopedics and rehabilitation.
Requisites: B M E 315 and M E 340, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

M E 417 – TRANSPORT PHENOMENA IN POLYMER PROCESSING
3 credits.

Description of the physical, thermal, mechanical, and rheological properties of polymeric materials relevant to their processing behavior. Review of the basic transport phenomena equations: mass, momentum, and energy. Analysis of various processing operations for the manufacture of polymeric articles, with particular emphasis on: extrusion, injection molding, blow molding, thermoforming, compression molding and additive manufacturing. Discussion of plastics recycling and environmental issues.
Requisites: Senior standing or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Summer 2023

M E 418 – ENGINEERING DESIGN WITH POLYMERS
3 credits.

Implications for plastics part design of polymer classification, structure, melt rheology, mixing, polymer blends, anisotropy, solidification, mechanical behavior, failure. Plastics design for electrical, optical, acoustic and barrier properties.
Requisites: Senior standing or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E 419 – FUNDAMENTALS OF INJECTION MOLDING
3 credits.

All major aspects of injection molding with emphases on design, processing, process physics, computer-aided engineering (CAE), troubleshooting, and advanced molding processes. Field trip, video presentation, case studies, term project with oral presentation, and hands-on sessions using commercial CAE simulation software.
Requisites: Senior standing, member of Engineering Guest Students, or declared in Capstone Certificate in Polymer Processing and Manufacturing
Repeatable for Credit: No
Last Taught: Fall 2023

M E 420 – INTRODUCTION TO POLYMER COMPOSITES PROCESSING
3 credits.

A brief description of the physical, thermal, rheological and mechanical properties of composite materials. Apply fundamental transport phenomena concepts to solve problems dealing with flow through porous media, fiber orientation, curing reactions, shrinkage and warpage and mechanics of composites. Introduction of various processing operations for the manufacture of composites products, with particular emphasis on resin transfer molding, vacuum assisted resin infusion, injection and compression molding, filament winding, braiding and pultrusion. The course includes laboratory experiments, CAE applied to composites product design, and a final group project producing a composites product.
Requisites: Senior standing or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Summer 2017

M E/STAT 424 – STATISTICAL EXPERIMENTAL DESIGN
3 credits.

Introduction to statistical design and analysis of experiments. Topics include: principles of randomization, blocking and replication, randomized blocking designs, Latin square designs, full factorial and fractional factorial designs and response surface methodology. Substantial focus will be devoted to engineering applications.
Requisites: STAT 240, 301, 302, 312, 324, 371, or MATH/STAT 310
Course Designation: Breadth - Natural Science
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2024

M E 429 – METAL CUTTING
3 credits.

Theory and applications of metal cutting; basic principles; significant features of current research. Chip formation mechanics, three-dimensional machining operations, tool life and machinability, economics of metal removal, and precision engineering.
Requisites: Senior standing and declared in Biomed, Biological Sys, Chemical, Civil, Computer, Electrical, Geological, Industrial, Mechanical or Nuclear Egr, Materials Sci & Egr, Egr Physics, Egr Mechanics, grad/professional standing or member of Egr Guest Students
Repeatable for Credit: No
Last Taught: Fall 2023

M E 437 – ADVANCED MATERIALS SELECTION
3 credits.

A structured approach is developed to address the complex problem of materials selection in design where multiple constraints and conflicting objectives need to be considered. Topics include: introductory fracture mechanics; corrosion and corrosion mitigation; effects of manufacturing processes and process selection; property development in metals, ceramics, polymers and composites; and material analysis techniques.
Requisites: (M S & E 350 and M E 310), M E 313, M S & E 332, graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2024

M E/E C E 439 – INTRODUCTION TO ROBOTICS
3 credits.

Hands-on introduction to key concepts and tools underpinning robotic systems in use and development today. Intended to give students the tools to understand robotic systems, to explore robotics for their own purposes, and to pursue advanced study in the field. Students are expected to have familiarity with a high level programming language such as Python (recommended), MATLAB, Java or Julia.
Requisites: Senior standing or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2023

M E 440 – INTERMEDIATE VIBRATIONS
3 credits.

Harmonic motion; natural frequencies and vibration of damped and undamped single and multi-degree of freedom systems; modal analysis; influence coefficients; lumped-mass modeling; dynamic load factors; Rayleigh's method; flow-induced vibrations; shaft whirl; balancing; vibration absorbers and tuned mass dampers; finite element modeling.
Requisites: (M E 306 or E M A 303) and (M E 340 or E M A/M E 540), or graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2023

M E 444 – DESIGN PROBLEMS IN ELASTICITY
3 credits.

Analysis of elastic systems by strain-energy techniques. Determination of stresses and deflections in statically indeterminate structures encountered in design. Resilience in springs.
Requisites: M E 306, E M A 303, graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2024

M E 445 – MECHATRONICS IN CONTROL & PRODUCT REALIZATION
3 credits.

Fundamentals of electromechanical control systems with a focus on subsystem design and their impacts at the system level. Integration of microcontrollers into products for control and/or instrumentation. Creation of intelligent interfaces between motors and sensors. C programming. Control computer system architecture Software and hardware principles for computer control.
Requisites: M E 376, E C E 376, 230, or (B M E 201 and B M E 310), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

M E 446 – AUTOMATIC CONTROLS
3 credits.

Sequencing control. Theory of linear feedback control systems with illustrative examples taken from applications encountered by mechanical engineers; differential equations for defining dynamic system response, Laplace transforms, and transient and frequency response concepts.
Requisites: M E 340, graduate/professional standing, member of Engineering Guest Students, or declared in Capstone Certificate in Power Conversion and Control
Repeatable for Credit: No
Last Taught: Fall 2023

M E 447 – COMPUTER CONTROL OF MACHINES AND PROCESSES
3 credits.

Discrete control theory reduced to engineering practice through a comprehensive study of discrete system modeling, system identification and digital controller design. Selected industrial processes and machines utilized as subjects on which computer control is to be implemented. Focus: computer control economics and planning as well as the control theory and programming.
Requisites: M E 340, 346, or 446, graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2024

M E 448 – MECHANICAL SYSTEMS ANALYSIS
3 credits.

Integrated treatment of mathematical modeling and analysis of mechanical systems. Modeling of linear and nonlinear systems and their performance under transient, periodic and random loads.
Requisites: Senior standing and declared in Biomed, Biological Sys, Chemical, Civil, Computer, Electrical, Geological, Industrial, Mechanical or Nuclear Egr, Materials Sci & Egr, Egr Physics, Egr Mechanics, Applied Math, Egr and Physics, grad/prof or EGRG
Repeatable for Credit: No
Last Taught: Fall 2020

M E 449 – REDESIGN AND PROTOTYPE FABRICATION
3 credits.

Principles of design, manufacturing, and prototype evaluation. A semester long project provides the opportunity to redesign of a thermo-mechanical device (Stirling Engine) using knowledge/skills acquired both through this course and previous course offerings in thermal sciences, mechanics and dynamics, manufacturing, and design. Instruction and hands-on experience using the manufacturing tools/processes available in the CoE. Design, dimensioning and tolerancing, manufacturing, and quantitative analysis are all covered in a structured semester project.
Requisites: Senior standing and (M E 306 or E M A 303), (M E 311 or 313 or concurrent enrollment), and M E 331, or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

M E 451 – KINEMATICS AND DYNAMICS OF MACHINE SYSTEMS
3 credits.

Graphical, analytical, and computer methods for the kinematic and dynamic analysis of mechanical linkages, mechanisms, and geared and cam systems.
Requisites: M E 240, E M A 202, PHYSICS 201, 207, 247, graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2023

M E 459 – COMPUTING CONCEPTS FOR APPLICATIONS IN ENGINEERING
3 credits.

An overview of computing concepts that support modeling and simulation in engineering applications. Learn the basics of computer architecture, software development and the interplay between software and hardware components.
Requisites: COMP SCI 200, 220, 300, 301, 302, 320, or placement into COMP SCI 300, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

M E 460 – APPLIED THERMAL / STRUCTURAL FINITE ELEMENT ANALYSIS
3 credits.

The course is designed for undergraduate students with no finite element (FE) analysis experience or knowledge. By the end of the semester the student will be able to simulate 1D, 2D and 3D structural and thermal systems, including both the static and transient response, using a common, commercially available FE software package. Analyses will be performed using both GUI and APDL. The emphasis of the course is on becoming proficient with the software and capable of operating an FE package at a high level, including benchmarking and verifying the FE model using simple analytical checks. An additional emphasis of the course is on understanding the impact of the temperature distribution in an object on the stress field through thermal expansion.
Requisites: M E 306 or E M A 303, or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

M E 461 – THERMAL SYSTEMS MODELING
3 credits.

Analysis and design of engineering systems involving applications of thermodynamics, economics, heat transfer, and fluid flow.
Requisites: M E 364 or concurrent enrollment, or graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2024

M E/M S & E 462 – WELDING METALLURGY
3 credits.

Metallurgical principles applied to welding; mechanisms of strengthening, phase equilibria, and microstructure of the weld zone. Modern processes including laser and electron beam welding.
Requisites: None
Repeatable for Credit: No
Last Taught: Fall 2023

M E 466 – AIR POLLUTION EFFECTS, MEASUREMENTS AND CONTROL
3 credits.

Overview of human health and environmental effects, and legislation regarding air pollution. Atmospheric transport and transformation of air pollutants. Emissions of air pollutants from power plants, transportation and industrial sources. Control technology for particulate and gaseous emissions. Monitoring and measurement of air pollutants. Application to boilers, engines, industrial processes and solid waste-to-energy technology.
Requisites: Senior standing and declared in Biomed, Biological Sys, Chemical, Civil, Computer, Electrical, Geological, Industrial, Mechanical or Nuclear Egr, Materials Sci & Egr, Egr Physics, Egr Mechanics, grad/professional standing or member of Egr Guest Students
Repeatable for Credit: No
Last Taught: Spring 2024

M E 468 – COMPUTER MODELING AND SIMULATION OF AUTONOMOUS VEHICLES AND ROBOTS
3 credits.

Introduction to the Robot Operating System (ROS). Concepts of vehicle dynamics modeling and simulation, with focus on tire, suspension, steering system, and powertrain modeling. Simulation of sensors (camera, lidar, radar, GPS, IMU). Terramechanics modeling for mobility on deformable terrains. Introduction to the autonomy stack (sensing, perception, planning, and control). Elements of artificial intelligence in autonomy. Elements of verification and validation.
Requisites: M E 459 and (COMP SCI 200, 220, 300, 301, 302, 320, or placement into COMP SCI 300), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022

M E 469 – INTERNAL COMBUSTION ENGINES
3 credits.

Fundamental principles of engine operation and application including cycle analysis, gas analysis, effect of operating conditions and engine design on air pollution.
Requisites: M E 361, or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E 471 – GAS TURBINE AND JET PROPULSION
3 credits.

Principles of thermodynamics and fluid dynamics utilized in the analysis and design of gas-turbine cycles, components and systems for stationary, automotive and aircraft applications.
Requisites: M E 364, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E 472 – ENERGY, SUSTAINABILITY, AND TECHNOLOGY
3 credits.

Thermodynamic analysis of energy conversion systems with emphasis on efficiency and greenhouse gas emissions; basic economic analysis of energy systems; radiative energy exchange with participating atmosphere; global energy balance; electricity production and transportation sustainability.
Requisites: M E 361 and (COMP SCI 200, 220, 300, 301, 310, or placement into COMP SCI 300), or graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E/BSE 474 – FLUID POWER
3 credits.

Engineering principles of design and analysis of fluid power systems and fluid power components. Topics include hydraulic fluid properties, fluid flow and, positive displacement pumps, valves for pressure, flow, and directional control, linear and rotary actuators, accumulators, pressure compensation, load sensing, energy management and system efficiency.
Requisites: M E 363, CIV ENGR 310, CBE 320, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E/BSE 475 – ENGINEERING PRINCIPLES OF AGRICULTURAL MACHINERY
3 credits.

Engineering design principles of machines for the production, processing and handling of crops for food, fuel, bio-mass and fiber. Environmental and biological factors that influence machine design and operation. Economic and capacity analysis of machines and systems.
Requisites: Declared in Biological Systems Engineering or Mechanical Engineering and (M E 240, E M A 202, PHYSICS 201, 207, or 247), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E/BSE 476 – ENGINEERING PRINCIPLES OF OFF-ROAD VEHICLES
3 credits.

Engineering design principles of heavy-duty vehicles intended for off-road use: fuels, engine cycles, engine principles and construction, clutches, mechanical and hydrostatic transmissions, final drives, traction systems, traction modeling, dynamic behavior, suspension systems and braking.
Requisites: (M E 361 or concurrent enrollment), (M E 240, E M A 202, PHYSICS 201, 207, or 247), and declared in Biological Systems Engineering or Mechanical Engineering or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

M E 489 – HONORS IN RESEARCH
1-3 credits.

Undergraduate honors research projects supervised by faculty members.
Requisites: Consent of instructor
Course Designation: Honors - Honors Only Courses (H)
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

M E 491 – MECHANICAL ENGINEERING PROJECTS I
1-3 credits.

Individual lab projects under staff supervision.
Requisites: Consent of instructor
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

M E 492 – MECHANICAL ENGINEERING PROJECTS II
1-3 credits.

Continuation of M E 491.
Requisites: Consent of instructor
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2023

M E/B M E 505 – BIOFLUIDICS
3 credits.

Introduction to the physics of biological fluid flow with an emphasis on the cardiovascular system including blood rheology, pulsatile flow, wave travel, and topics relevant to blood flow measurement and biomedical device design.
Requisites: B M E 330, CBE 320, M E 363, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

M E/CIV ENGR/E M A 508 – COMPOSITE MATERIALS
3 credits.

Physical properties and mechanical behavior of polymer, metal, ceramic, cementitious, cellulosic and biological composite systems; micro- and macro-mechanics; lamination and strength analyses; static and transient loading; fabrication; recycling; design; analytical-experimental correlation; applications.
Requisites: (E M A 303 or M E 306), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

M E/I SY E 510 – FACILITIES PLANNING
3 credits.

Introduction to plant location theory and analysis of models of plant location; models for determining plant size and time phasing; line balancing models; techniques for investigating conveyor and other material handling problems; and models of plant layout.
Requisites: I SY E 315, (I SY E 323 or E C E/COMP SCI/I SY E 524) and I SY E/PSYCH 349, or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E/I SY E 512 – INSPECTION, QUALITY CONTROL AND RELIABILITY
3 credits.

Inspection data for quality control; sampling plans for acceptance inspection; charts for process control. Introduction to reliability models and acceptance testing.
Requisites: (STAT/MATH 309, STAT 311, 224, 324, or STAT/MATH 431), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

M E 514 – POLYMER ADDITIVE MANUFACTURING
3 credits.

A quantitative and qualitative study of additive manufacturing processes. Emphasis on proper additive manufacturing technique selection for optimized final product design and properties, as well as presentation of emerging additive manufacturing techniques.
Requisites: Senior standing and (M E 310 or 313), graduate/professional standing, member of Engineering Guest Students, or declared in Capstone Certificate in Polymer Processing and Manufacturing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

M E/B M E 516 – FINITE ELEMENTS FOR BIOLOGICAL AND OTHER SOFT MATERIALS
3 credits.

Finite element modeling of soft materials, with an emphasis on biological tissues. Basics of the finite element method, verification and validation methods, and selection of constitutive models. Emphasis on finite element modeling for materials that are generally nonlinear, and that generally undergo large deformation.
Requisites: (M E 306 or E M A 303), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

M E/N E 520 – TWO-PHASE FLOW AND HEAT TRANSFER
3 credits.

Two-phase flow and heat transfer in engineering systems. Pool boiling and flow boiling. Phenomenological modeling.
Requisites: M E 361 and (M E 364 or CBE 320), or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

M E/CBE 525 – MACROMOLECULAR HYDRODYNAMICS
3 credits.

Observed phenomena in polymeric flow systems. Techniques of viscometry and viscoelastic measurements for polymeric fluids. Rheological models. Analytical solutions to flow problems: non-Newtonian viscosity, linear viscoelasticity, normal stresses, recoil, stress relaxation, etc. Dimensional analysis. Unit operations of the polymer industry: extrusion, blow molding, injection molding, mixing.
Requisites: M E 363, CBE 320, member of Engineering Guest Students, or graduate/professional standing
Repeatable for Credit: No
Last Taught: Spring 2015

M E 529 – SMART MANUFACTURING
3 credits.

Introduction to "Smart Manufacturing," including the basic knowledge needed to understand how a company can connect its operational technology systems (e.g., machine tools) to its information technology systems, and how this can improve operational efficiency. Terminology, sensors and data, data communication, cyber-security, closed-loop (feedback) control theory, control theoretic applications, and automation for manufacturing. Provides the basis for making informed decisions about how manufacturing processes and systems can be made more adaptive (flexible) by automating, collecting the right data, and applying closed-loop (feedback) control: I.e., cyber-physical systems.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E 531 – DIGITAL DESIGN AND MANUFACTURING
3 credits.

Broad overview of concepts, methods and tools for manipulating digital geometric models for engineering design and manufacturing. Topics include freeform curves, surfaces, and solid modeling. Topics also include slicing, support generation and path planning for additive and subtractive manufacturing. Provides both cutting-edge knowledge and hands-on project experiences in digital design and manufacturing. It will involve the use of CAD software for creative shape design. It will also involve 3D printers and 3D scanners in the ME Instructional Lab and Maker Space.
Requisites: Senior standing or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

M E/COMP SCI/E C E 532 – MATRIX METHODS IN MACHINE LEARNING
3 credits.

Linear algebraic foundations of machine learning featuring real-world applications of matrix methods from classification and clustering to denoising and data analysis. Mathematical topics include: linear equations, regression, regularization, the singular value decomposition, and iterative algorithms. Machine learning topics include: the lasso, support vector machines, kernel methods, clustering, dictionary learning, neural networks, and deep learning. Previous exposure to numerical computing (e.g. Matlab, Python, Julia, R) required.
Requisites: (MATH 234, 320, 340, 341, or 375) and (E C E 203, COMP SCI 200, 220, 300, 301, 302, 310, 320, or placement into COMP SCI 300), graduate/professional standing, or declared in Capstone Certificate in Computer Sciences for Professionals
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

M E 535 – COMPUTER-AIDED GEOMETRIC DESIGN
3 credits.

Designed to acquaint the student with computer-aided design technology used for geometric design of engineered products. Currently used methods of creating three-dimensional computer-aided design (CAD) models will be discussed. Paradigms of three-dimensional wire-frame modeling, surface modeling and solids modeling as applied in product design. Techniques for freeform curve and surface modeling will be emphasized.
Requisites: Senior standing or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E 536 – DATA DRIVEN ENGINEERING DESIGN
3 credits.

Introduction to data-driven techniques for surrogate modeling based engineering design. Apply data-driven approaches to engineering design problems such as design of structural and thermofluid components and systems.
Requisites: (MATH 234 or 376), (MATH 320, 340, 341, or 375), and (I SY E 210, B M E 325, E C E 331, MATH/STAT 310, STAT 312, 324, 333 or 340), or graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No

M E/COMP SCI/E C E 539 – INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS
3 credits.

Theory and applications of artificial neural networks: multi-layer perceptron, self-organization mapdeep neural network convolutional neural network, recurrent network, support vector machines genetic algorithm, and evolution computing. Applications to control, pattern recognition, prediction, and object detection and tracking.
Requisites: COMP SCI 200, 220, 300, 301, 302, 310, placement into COMP SCI 300, or graduate/professional standing
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2024

M E/E M A 540 – EXPERIMENTAL VIBRATION AND DYNAMIC SYSTEM ANALYSIS
3 credits.

Application of digital data acquisition to the investigation of mechanical components, structures and systems using time histories, transforms and response functions to characterize free, forced and transient inputs. Introduction to sensors, instrumentation and methods appropriate for dynamic system response.
Requisites: (M E 440, E M A 545, or concurrent enrollment) or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E 548 – INTRODUCTION TO DESIGN OPTIMIZATION
3 credits.

Introduces basic concepts and techniques used in the optimization of engineering design components and systems. Pose and solve typical optimization problems such as truss and finite-element-based optimization.
Requisites: M E 306 or E M A 303, or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

M E 549 – PRODUCT DESIGN
3 credits.

A project oriented, interdisciplinary course with an emphasis on designing competitive, quality products. The product development process is covered from problem identification through detail design and evaluation. Included among the topics covered are: idea generation and evaluation, visualization, and quality.
Requisites: Senior standing and declared in Biomed, Biological Sys, Chemical, Civil, Computer, Electrical, Geological, Industrial, Mechanical or Nuclear Egr, Materials Sci & Egr, Egr Physics, Egr Mechanics, grad/professional standing or member of Egr Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E/COMP SCI/I SY E 558 – INTRODUCTION TO COMPUTATIONAL GEOMETRY
3 credits.

Introduction to fundamental geometric computations and algorithms, and their use for solving engineering and scientific problems. Computer representations of simple geometric objects and paradigms for algorithm design. Applications from areas of engineering analysis, design and manufacturing, biology, statistics, and other sciences.
Requisites: (COMP SCI 367 or 400) and MATH 234 or graduate/professional standing
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2018

M E 561 – INTERMEDIATE THERMODYNAMICS
3 credits.

Fundamentals; phase and chemical equilibria; availability; thermodynamic relationships.
Requisites: M E 361 or CBE 311, or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E 563 – INTERMEDIATE FLUID DYNAMICS
3 credits.

Incompressible and compressible, laminar and turbulent flow of fluids. Classical and finite-difference analysis using differential and integral formulation of the continuity, momentum and energy equations. Application to ducts, plates, spheres, blades, pumps, turbines, lubrication, shockwaves, nozzles, diffusers and other mechanical engineering equipment.
Requisites: M E 363, or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

M E 564 – HEAT TRANSFER
3 credits.

Applications of conduction, convection, and thermal-radiation principles to combined-mode problems; analytical and numerical techniques; heat-exchanger design; thermal stresses.
Requisites: M E 364, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

M E/N E 565 – POWER PLANT TECHNOLOGY
3 credits.

Design and performance of power plants for the generation of electric power; fossil and nuclear fuels, cycle analysis, component design and performance, plant operation, control, economics and environmental impact. Advanced concepts.
Requisites: M E 361, or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Fall 2023

M E/E P 566 – CRYOGENICS
3 credits.

Applications of cryogenics, material properties at low temperatures, refrigeration and liquefaction systems, measurement techniques, insulation, storage and transfer of cryogenics, safety and handling.
Requisites: (M E 361 or PHYSICS 415) and (CBE 320 or M E 364), or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2019

M E/CBE 567 – SOLAR ENERGY TECHNOLOGY
3 credits.

Radiant energy transfer and its application to solar exchangers; energy balances for solar exchangers, review of theory, economics, and practice of solar energy applications.
Requisites: (M E 364, CBE 326, or concurrent enrollment), or graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2023

M E 569 – APPLIED COMBUSTION
3 credits.

Introduction to and analysis of combustion processes and combustion technology for gaseous, liquid, and solid fuels. Application to combustion engines, furnaces, fixed-bed, fluidized-bed, and suspension burning boilers.
Requisites: M E 364, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E/E M A 570 – EXPERIMENTAL MECHANICS
3 credits.

Experimental methods for design and analysis of mechanical components, structures and materials. Electrically and optically recorded stress, strain and deformation data; computer acquisition/reduction/presentation techniques; applications to static and transient events, sensors, transducer design, NDT, fracture and residual stresses.
Requisites: Senior standing and (M E 306, E M A 303 or 304) or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

M E 572 – INTERMEDIATE GAS DYNAMICS
3 credits.

Thermodynamics and fluid dynamics of compressible gas flows with friction and heat transfer, and application to nozzles, shock tubes and propulsion devises. Wave phenomena and engine port tuning. Physics of high temperature gases and equilibrium, non-equilibrium and frozen flows.
Requisites: M E 363, or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

M E 573 – COMPUTATIONAL FLUID DYNAMICS
3 credits.

Provides an in-depth introduction to the methods and analysis techniques used in computational solutions of fluid mechanics and heat transfer problems. Model problems are used to study the interaction of physical processes and numerical techniques. Contemporary methods for boundary layers, incompressible viscous flows, and inviscid compressible flows are studied. Finite differences and finite volume techniques are emphasized. Knowledge of programming language such as Python, C++, MATLAB or Java required.
Requisites: M E 363, or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E/E C E 577 – AUTOMATIC CONTROLS LABORATORY
4 credits.

Control theory is reduced to engineering practice through the analysis and design of actual systems in the laboratory. Experiments are conducted with modern servo systems using both analog and digital control. Systems identification and modern controls design are applied to motion and torque control.
Requisites: M E 346 or E C E 332, or graduate/professional standing or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

M E 601 – SPECIAL TOPICS IN MECHANICAL ENGINEERING
1-3 credits.

Advanced topics of special interest in various areas of Mechanical Engineering, such as vibrations, balancing, lubrication and wear, special manufacturing processes, automation, energy systems, etc.
Requisites: Senior standing or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

M E/B M E 605 – SPECIAL TOPICS IN BIOMECHANICS
1-3 credits.

Various special topics in biomechanics.
Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

M E/B M E 615 – TISSUE MECHANICS
3 credits.

Focus on solid mechanics of prominent musculoskeletal and cardiovascular tissues. Their normal and pathological behaviors (stiffness, strength, relaxation, creep, adaptive remodeling, etc.) in response to physiologic loading will be examined and quantified.
Requisites: M E 306 or E M A 303, or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E/I SY E 641 – DESIGN AND ANALYSIS OF MANUFACTURING SYSTEMS
3 credits.

Covers a broad range of techniques and tools relevant to the design, analysis, development, implementation, operation and control of modern manufacturing systems. Case studies assignments using industry data will be used to elaborate the practical applications of the theoretical concepts.
Requisites: I SY E 315, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

M E/I SY E 643 – PERFORMANCE ANALYSIS OF MANUFACTURING SYSTEMS
3 credits.

Examines the state of the art in the use of stochastic network theory to develop performance models of modern manufacturing systems.
Requisites: (I SY E 624 or STAT/I SY E/MATH/OTM 632) and (COMP SCI 200, 220, 300, 301, 302, 400, or placement into COMP SCI 300), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2021

M E 669 – ENGINE EXPERIMENTS
3 credits.

Hands-on experience with engine hardware testing, especially as it relates to required information for setting up and validating computational models.
Requisites: M E 364, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Summer 2023

M E 673 – INTERNAL COMBUSTION ENGINE SIMULATIONS
3 credits.

Hands-on experience with engine CFD (computational fluid dynamics) simulations and use of engine data to validate computational predictions.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Summer 2023

M E 699 – ADVANCED INDEPENDENT STUDY
1-3 credits.

Directed study projects as arranged with instructor.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

M E 702 – GRADUATE COOPERATIVE EDUCATION PROGRAM
1-2 credits.

Work experience that combines classroom theory with practical knowledge of operations to provide students with a background on which to develop and enhance a professional career. The work experience is tailored for MS students from within the U.S. as well as eligible international students.
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

M E/E M A 703 – PLASTICITY THEORY AND PHYSICS
3 credits.

Physical foundations of plasticity as a basis for choices made in the formulation of theories representing plastic deformation and their limitation. Motion of dislocations and formation and growth of deformation twins. Experimental results in the context of plasticity models. Traditional and research topics of plasticity and theories for rate-independent, rate-dependent, single and polycrystal descriptions. Numerical solution of equations and computational plasticity. Knowledge of mechanics of materials [such as E M A 303 or M E 306] and continuum mechanics [such as E M A 622] required.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E/E M A 706 – PLATES, SHELLS AND PRESSURE VESSELS
3 credits.

Stress and deflection analysis of structural plates and membranes under mechanical and thermal loads; variational and numerical methods; instability and vibrations; membrane shell theory; cylindrical shells; pressure vessel and piping design applications; ASME Pressure Vessel Code. Knowledge of mechanics of materials [such as M E 444 or E M A 506] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

M E/E M A 708 – ADVANCED COMPOSITE MATERIALS
3 credits.

Contemporary topics such as new materials; smart materials/structures/systems; fatigue; fracture; experimental techniques; nondestructive evaluation; transient, micro, three-dimensional, nonlinear, inelastic and environmental effects; manufacturing methods: repair and applications. Knowledge of composite materials [such as E M A/CIV ENGR/M E 508] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2016

M E/B M E 715 – ADVANCED TISSUE MECHANICS
3 credits.

Central topics in solid mechanics applied to soft tissues, including analysis of strain in the setting of large deformations, computation of stress in multiple experimental loading configurations, constitutive modeling of biomaterials using hyperelastic strain-energy functions, modeling tissue growth and remodeling, and the main theories for soft tissue failure will be covered. Application of finite elasticity theory in practical laboratory situations, and key papers and concepts in soft tissue mechanics.
Requisites: (M E/B M E 615 or E M A 622) and graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E 717 – ADVANCED POLYMER PROCESSING
3 credits.

Advanced analysis and modeling of plastics extrusion, injection molding, and other processes; mold and equipment design; materials consideration. Knowledge of polymer processing [such as M E 417] strongly encouraged.
Requisites: Graduate/professional standing or declared in Capstone Certificate in Polymer Processing and Manufacturing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E 718 – MODELING AND SIMULATION IN POLYMER PROCESSING
3 credits.

This course is designed to acquaint the student with computer simulation technology used for the engineering of polymer processes. Knowledge of polymer processing [such as M E 417] strongly encouraged.
Requisites: Graduate/professional standing or declared in Capstone Certificate in Polymer Processing and Manufacturing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

M E/E M A 722 – INTRODUCTION TO POLYMER RHEOLOGY
3 credits.

Formulation of constitutive equations using embedded base vectors. Viscosity, normal stress differences, stress relaxation, elastic recoil. Polymer rheology; homogeneous strain history. Knowledge of differential equations [such as MATH 320] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Summer 2023

M E/E C E 739 – KINEMATICS, DYNAMICS, AND CONTROL OF ROBOTIC MANIPULATORS
3 credits.

Robotics analysis and design, focusing on the analytical fundamentals specific to robotic manipulators. Serial chain robotic manipulator forward and inverse kinematics, differential kinematics, dynamics, motion planning, and controls. Knowledge of linear algebra [such as MATH 320], high-level computational programming language such as MATLAB, and system dynamics [such as M E 340] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

M E 740 – ADVANCED VIBRATIONS
3 credits.

Vibration of mechanical components subject to dynamic loads; analytical, numerical and finite element methods applied to the analysis and design of mechanical systems consisting of cables, bars, shafts, beams, frames, rings, membranes, plates and shells. Knowledge of vibrations [such as M E 440] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

M E 746 – DYNAMICS OF CONTROLLED SYSTEMS
3 credits.

Emphasis on obtaining equations which define the behavior of physical systems frequently subjected to control; mechanical processing, fluid power, and thermal systems; analytical, experimental, and computer techniques. Knowledge of Automatic Controls [such as M E 446 or E C E 332] is required.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

M E 747 – ADVANCED COMPUTER CONTROL OF MACHINES AND PROCESSES
3 credits.

Digital control theory, design methodology, and techniques for controller implementation on digital computers. Advanced single and multi-axis motion generation algorithms. Multiple processor control systems. Multiple objective control systems for machinery guidance and manufacturing processes. Precision control. Knowledge of digital control [such as M E 447] strongly encouraged.
Requisites: (M E 446 or E C E 332) and graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E 748 – OPTIMUM DESIGN OF MECHANICAL ELEMENTS AND SYSTEMS
3 credits.

Formulation and solution of mechanical design problems by use of mathematical programming methods.
Requisites: M E 548 and graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

M E 751 – ADVANCED COMPUTATIONAL DYNAMICS
3 credits.

Overview of techniques used to understand the time evolution (dynamics) of multi-body mechanical engineering systems. Modeling, equation formulation, and numerical methods used to determine the dynamics of multi-body mechanical systems. Rigid and flexible multi-body dynamics, friction and contact. Knowledge of Python or MATLAB strongly recommended. Knowledge of dynamic systems [such as M E 240 or 340] required.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2020

M E 753 – FRICTION, LUBRICATION AND WEAR
3 credits.

Behavior of frictional surfaces under different types of loading. Mechanisms of heat generation and surface damage (wear, scuffing, pitting, fretting, etc.). Rheological effects. Effect of lubrication. Surface interaction in metal cutting. Design considerations. Knowledge of mechanics/strength of materials [such as E M A 303 or M E 306] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

M E 758 – SOLID MODELING
3 credits.

Mathematical modeling, computer representations, and algorithms for manipulation of two- and three-dimensional shapes on a computer. Applications of shape modeling to design, representation, and analysis of mechanical parts and processes; other engineering and scientific applications of shape and solid modeling. Knowledge of advanced programming [such as COMP SCI 400] and knowledge of linear algebra [such as MATH 340] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2020

M E/COMP SCI/E C E/E M A/E P 759 – HIGH PERFORMANCE COMPUTING FOR APPLICATIONS IN ENGINEERING
3 credits.

An overview of hardware and software solutions that enable the use of advanced computing in tackling computationally intensive Engineering problems. Hands-on learning promoted through programming assignments that leverage emerging hardware architectures and use parallel computing programming languages. Students are strongly encourage to have completed COMP SCI 367 or COMP SCI 400 or to have equivalent experience.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E 761 – TOPICS IN THERMODYNAMICS
3 credits.

Thermostatic behavior of nonideal gases; equations of state, with emphasis on their empirical and statistical development, including mixture rules; more detailed study of chemical and phase equilibrium; selected applications of the foregoing; real gas processes, combustion, direct energy conversion devices. Knowledge of thermodynamics [such as M E 561] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Summer 2023

M E 764 – ADVANCED HEAT TRANSFER I-CONDUCTION
3 credits.

Analytical methods in conduction; Bessel functions, separation of variables, Laplace transforms, superposition, oscillating solutions; computer methods; finite differences, finite elements. Knowledge of basic heat transfer [such as M E 564] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

M E 768 – PRECISION MEASUREMENTS
3 credits.

General concepts for predicting, characterizing, and reducing noise in measurements. Address the key questions of all experimentalists: (1) How can I improve my signal-to-noise ratio? (2) What is the ultimate detection limit of my measurement approach? Knowledge of Matlab programming and basic circuit design [such as E C E 230] is required.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

M E 769 – COMBUSTION PROCESSES
3 credits.

Combustion theory and practice. Thermodynamics of combustion, flame theory, detonation, spray and droplet combustion related to various engine applications. Knowledge of internal combustion engines [such as M E 469], thermodynamics [such as M E 561], and combustion [such as M E 569] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

M E 770 – ADVANCED EXPERIMENTAL INSTRUMENTATION
3 credits.

Theory and design of instruments for transient physical phenomena especially related to internal combustion engines. Basic knowledge of kinetic theory of gases, statistical mechanics, and quantum mechanics for gases, and measurement theory [such as M E 601: Physics of Gases] required.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

M E 774 – CHEM KINETICS OF COMBUST SYSTEMS
3 credits.

Application of gas-phase chemical reaction rate theory to power and propulsion systems, both earthbound and airborne. Aerothermochemistry, kinetics of combustion reactions, kinetics related to air pollutant generation. Development and comparison of transition state theory, collision theory and bond-energy-bond-order method. Intermediate knowledge of thermodynamics and combustion and basic understanding of kinetic theory of gases, statistical mechanics, and quantum mechanics for gases [such as M E 601: Physics of Gases] required.
Requisites: M E 569 and graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022

M E/CIV ENGR/E M A 775 – TURBULENT HEAT AND MOMENTUM TRANSFER
3 credits.

Stochastic methods in turbulent heat and momentum transfer; fully developed turbulence; numerical methods including model applications to boundary layers, reacting flows, mass transfer, and unsteady flows; linear and non-linear stability and transition; emphasis on applications of interest to Mechanical, Aerospace, and Environmental Engineers. Knowledge of fluid mechanics [such as M E 363 or CBE 320] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

M E/E P 777 – VACUUM TECHNOLOGY
3 credits.

Topics defining modern vacuum technology, including the kinetic theory of gases, conductance, pumping systems, pump technologies, pressure measurement, gas-surface interactions, sealing technologies, leak detection, and residual gas analysis will be addressed through a combination of lectures, laboratory activities, problem solving, and group discussions. Knowledge of fluid mechanics [such as M E 363 or B M E 320] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022

M E 790 – MASTER'S RESEARCH AND THESIS
1-9 credits.

Directed study projects as arranged with instructor.
Requisites: Declared in a Mechanical Engineering graduate program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

M E 890 – PHD RESEARCH AND THESIS
1-9 credits.

Directed study projects as arranged with instructor.
Requisites: Declared in a Mechanical Engineering graduate program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

M E 903 – GRADUATE SEMINAR
0 credits.

Topics vary.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

M E 964 – SPECIAL ADVANCED TOPICS IN MECHANICAL ENGINEERING
1-3 credits.

Advanced topics in design, manufacturing, energy, etc.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

M E 990 – DISSERTATOR RESEARCH AND THESIS
1-9 credits.

Directed study projects as arranged with instructor.
Requisites: Declared in Mechanical Engineering PhD
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

M E 999 – ADVANCED INDEPENDENT STUDY
1-5 credits.

Directed study projects as arranged with instructor.
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Summer 2022