

# MECHANICAL ENGINEERING (ME)

undefined

## ME Courses

### ME 128. Introduction to Mechanical Engineering I. 1 unit

Term Typically Offered: F

Prerequisite: Mechanical Engineering student; first quarter of freshman year. Concurrent: ME 163.

Introduction to mechanical engineering and its application in professional practice. Includes design, analysis, testing and dissection of mechanical engineering systems, from simple machines to more complicated systems. Introduction to engineering graphic communication. Introduction to HVAC, Manufacturing and Mechatronics concentrations. Includes cornerstone service learning project. 1 laboratory.

### ME 129. Introduction to Mechanical Engineering II. 1 unit

Term Typically Offered: W

Prerequisite: ME 128; Mechanical Engineering student; second quarter of freshman year. Concurrent: IME 145.

Communication of designs for manufacturing using basic definitions of points, lines and planes in space. Pictorials, orthographic projection, section views and auxiliary views. Techniques from geometry and spatial definitions integrated to provide information to both the design and manufacturing processes. 1 laboratory.

### ME 130. Introduction to Mechanical Engineering III. 1 unit

Term Typically Offered: SP

Prerequisite: ME 129; Mechanical Engineering student; third quarter of freshman year. Corequisite: IME 146.

Use of computer-aided design to communicate parts and assemblies. Dimensioned drawings for part fabrication. Introduction to fits and tolerances. Layout drawings and functional assemblies. 1 laboratory.

### ME 161. Introduction to Composite Materials Manufacturing. 2 units

Term Typically Offered: F, SP, SU

Reinforcing fibers and matrix materials both synthetic and natural. Composite material molding and forming processes including hand layup, autoclave, compression molding, filament winding, and vacuum infusion molding. Mold, mandrel or tooling design. Composite component post-processing and machining. 2 laboratories.

### ME 163. Freshmen Orientation to Mechanical Engineering. 1 unit

Term Typically Offered: F

Concurrent: ME 128.

Introduction to career opportunities in Mechanical Engineering, exploration of the ethical responsibilities of being a student and professional engineer, and familiarization with the Mechanical Engineering curriculum including cooperative education and international exchange opportunities. Cornerstone service learning project. Field trip may be required. 1 activity.

### ME 211. Engineering Statics. 3 units

Term Typically Offered: F,W,SP,SU

Prerequisite: MATH 241 (or concurrently), PHYS 131 or PHYS 141.

Analysis of forces on engineering structures in equilibrium. Properties of forces, moments, couples, and resultants. Equilibrium conditions, friction, centroids, area moments of inertia. Introduction to mathematical modeling and problem solving. Vector mathematics where appropriate. Course may be offered in classroom-based, online, or hybrid format. 3 lectures. Crosslisted as HNRS/ME 211.

### ME 212. Engineering Dynamics. 3 units

Term Typically Offered: F,W,SP,SU

Prerequisite: MATH 241; ME 211 or ARCE 211.

Analysis of motions of particles and rigid bodies encountered in engineering. Velocity, acceleration, relative motion, work, energy, impulse, and momentum. Further development of mathematical modeling and problem solving. Vector mathematics where appropriate. Course offered in hybrid format with classroom-based and online learning. 3 lectures. Crosslisted as HNRS 214/ME 212.

### ME 228. Engineering Design Communication. 2 units

Term Typically Offered: F, W, SP

Use of engineering communication principles to communicate details of project designs including: sketching, orthographic projection, section and auxiliary views, dimensioning, and tolerances. Hand and computer based methods explored. Introduction to design for manufacturability. 2 laboratories.

### ME 229. Introduction to Mechanical Engineering for Transfers. 2 units

Term Typically Offered: TBD

Introduction to Mechanical Engineering and its application in professional practice. Includes design, analysis, testing and dissection of mechanical engineering systems. Investigation of personal and professional ethics. Familiarization with the ME curriculum including cooperative education and international exchange opportunities. 1 lecture, 1 laboratory.

### ME 234. Philosophy of Design. 3 units

Term Typically Offered: F,W,SP,SU

Prerequisite: Sophomore standing.

General approach to the meaning of engineering design. Conceptual blocks, creativity, design process, design considerations and elements. Course may be offered in classroom-based or online format. 3 lectures.

### ME 236. Measurement and Engineering Data Analysis. 3 units

Term Typically Offered: F, W, SP

Prerequisite: Engineering majors. Recommended: CHEM 125, ENGL 149, and PHYS 132 or PHYS 142.

Introduction to principles and practice of measurement. Application of probability distributions, sampling, confidence intervals, uncertainty, and regression analysis to engineering experiments and design. Techniques for measuring common physical quantities such as temperature, pressure, and strain. Introduction to laboratory report writing and communication of technical data. 2 lectures, 1 laboratory.

**ME 251. Introduction to Detailed Design with Solid Modeling. 2 units**

Term Typically Offered: F, W, SP

Prerequisite: ME 130 or ME 228. Recommended: IME 143 or IME 146.

Part and system or assembly design with solid modeling using current software and hardware. Techniques of advanced communication including weld symbols, threaded fasteners, dimensioning and tolerancing. Creation of design layouts and part models with varied configurations and dynamic assembly models. Introduction to section mass and inertia properties. Emphasis of group work and peer review in the production of parts for assemblies. 1 lecture, 1 laboratory.

**ME 263. Introduction to Mechanical Engineering for Transfer Students. 1 unit**

Term Typically Offered: F, SP, SU

Introduction to mechanical engineering and its application in professional practice. Investigation of personal and professional ethics. Familiarization with the ME curriculum including cooperative education and international exchange opportunities. Course may be offered in classroom-based or online format. 1 lecture.

**ME 264. Introduction to Mechanical Engineering for Transfers Lab. 1 unit**

Term Typically Offered: F, SP

Introduction to Mechanical Engineering and its application in professional practice. Includes design, analysis, testing and dissection of mechanical engineering systems. 1 laboratory.

**ME 270. Selected Topics. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Open to undergraduate students and consent of instructor.

Directed group study of selected topics. The Class Schedule will list topic selected. Total credit limited to 8 units. 1 to 4 lectures.

**ME 271. Selected Laboratory. 1-2 units**

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Directed group laboratory study of selected topics. The Class Schedule will list topic selected. Total credit limited to 4 units. 1 to 2 laboratories.

**ME 302. Thermodynamics I. 3 units**

Term Typically Offered: F,W,SP,SU

Prerequisite: ME 212 and PHYS 132 or PHYS 142.

Properties of working fluids and fundamental relations for processes involving the transfer of energy. First and second laws of thermodynamics, irreversibility and availability. 3 lectures.

**ME 303. Thermodynamics II. 3 units**

Term Typically Offered: F,W,SP,SU

Prerequisite: ME 302.

Vapor and gas power cycles, refrigeration cycles, thermodynamic relations, psychrometrics, and chemical reactions. Course may be offered in classroom-based, online, or hybrid format. 3 lectures.

**ME 305. Introduction to Mechatronics. 4 units**

Term Typically Offered: F, SP

Prerequisite: EE 201 and EE 251.

Introduction to microcontrollers and assembly language programming. Emphasis on components and techniques for interfacing that are typical of embedded microcontroller applications (A/D conversion, D/A conversion, interrupts, timers, and pulse-width modulation). Laboratory exercises involve real-time interfacing of microcontrollers to external mechanical and/or electromechanical devices. 3 lectures, 1 laboratory.

**ME 313. Engineering Principles in Everyday Life. 4 units**

Term Typically Offered: F

2020-21 or later: Upper-Div GE Area B

2019-20 or earlier catalog: GE Area B5, B6, or B7

Prerequisite: Junior standing; completion of GE Area A with grades of C- or better; one course in GE Area B4 with a grade of C- or better (GE Area B1 for students on the 2019-20 or earlier catalogs); and MATH 118 or equivalent. Recommended: PHYS 121.

Discover engineering principles and concepts such as natural frequencies, entropy, Coriolis acceleration, and Faraday's Law that govern our everyday lives, many aspects of human body, and consumer products. 4 lectures. Fulfills GE Area Upper-Division B (GE Areas B5, B6, or B7 for students on the 2019-20 catalog).

**ME 318. Mechanical Vibrations. 4 units**

Term Typically Offered: F,W,SP,SU

Prerequisite: ME 212, MATH 344. Recommended: EE 201.

Free and forced vibration response of single and multiple degree of freedom systems. Experimental studies of the dynamic behavior of structures and machines. Instrumentation methods utilized in field and laboratory. 3 lectures, 1 laboratory.

**ME 322. Introduction to System Dynamics. 4 units**

Term Typically Offered: F,W,SP,SU

Prerequisites: CPE/CSC 101 or CSC 231 or CSC 234; EE 201; EE 251; ME 318; ME 341.

Unified approach for mathematical modeling and numerical analysis of dynamic physical systems that store energy in multiple domains. Emphasis on developing lumped-parameter linear models from primitive elements in a systematic manner. 3 lectures, 1 laboratory.

**ME 326. Intermediate Dynamics. 4 units**

Term Typically Offered: F,W,SP,SU

Prerequisite: ME 212; CPE/CSC 101 or CSC 231 or CSC 234. Corequisite: MATH 244.

Continuation of ME 212. Additional analysis of planar motion of rigid bodies with particular attention to rotating reference frames. Kinematics of linkages, three dimensional dynamics, introduction to numerical methods and dynamic simulation of mechanisms. 3 lectures, 1 activity.

**ME 328. Design for Strength and Stiffness. 4 units**

Term Typically Offered: F, W, SP

Prerequisite: BMED 212 or ME 234; CE 207 or CE 208; MATE 210; and ME 212. Corequisite: CPE/CSC 101, CSC 231, or CSC 234; and ME 251.

Design of machine parts by stress and deflection. Effects of fluctuating stresses and stress concentration. Design of shafts and other machine parts. Modern industrial design practice using standard components and design layout drawings. Course may be offered in classroom-based or online format. 3 lectures, 1 laboratory.

**ME 329. Mechanical Systems Design. 4 units**

Term Typically Offered: F, W, SP

Prerequisite: ME 328.

Design of mechanical equipment and systems using various machine elements and components such as threaded fasteners, power screws, springs, gears, bearings, clutches, prime movers, etc. Decision modeling based on technical and economic feasibility. 3 lectures, 1 laboratory.

**ME 341. Fluid Mechanics I. 3 units**

Term Typically Offered: F,W,SPSU

Prerequisite: MATH 242 or MATH 244; ME 212.

Fluid properties and fluid statics. Euler and Bernoulli equations. Conservation equations; dimensional analysis. Viscous pipe flow. Course may be offered in classroom-based or online format. 3 lectures.

**ME 343. Heat Transfer. 4 units**

Term Typically Offered: F, W, SP

Prerequisite: CPE/CSC 101, CSC 231, or CSC 234; and ME 236, ME 302, and ME 341.

Basic principles of heat transfer by conduction, convection, and radiation. Laboratory experiments to characterize thermodynamic material properties, energy conversion processes, thermodynamic cycles, and performance of heat transfer equipment. 3 lectures, 1 laboratory. Replaces ME 350.

**ME 347. Fluid Mechanics II. 4 units**

Term Typically Offered: F, W, SP

Prerequisite: ME 236, ME 341, ME 302.

Conservation equations of fluid dynamics. Viscous flow, boundary layer concepts, lift and drag, compressible flow, turbomachinery. Laboratory measurement of turbomachine performance, velocity profiles, boundary layers on surfaces. 3 lectures, 1 laboratory.

**ME 359. Fundamentals of HVAC Systems. 4 units**

Term Typically Offered: W

Corequisite: ME 302.

Fundamentals of heating, ventilating and air-conditioning (HVAC) systems, human comfort and indoor air quality, primary and secondary systems and components. Course may be offered in classroom-based, online, or hybrid format. 3 lectures, 1 laboratory.

**ME 361. Fundamentals of Fire Protection Engineering. 4 units**

Term Typically Offered: SP

Prerequisite: Junior standing; completion of GE Area A with grades of C- or better; and completion of GE Areas B1 through B4, with a grade of C- or better in one course in GE Area B4 (GE Area B1 for students on the 2019-20 or earlier catalogs).

Fundamental physical and design principles of fire protection engineering. Fire safety strategy, egress, human behavior, fire dynamics, smoke control, alarm and detection, suppression, structural behavior, failure analysis, and engineering ethics. Course may be offered in classroom-based or online format. 3 lectures, 1 laboratory.

**ME 400. Special Problems for Advanced Undergraduates. 1-4 units**

Term Typically Offered: F, W, SP

Prerequisite: Consent of instructor.

Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 4 units.

**ME 401. Stress Analysis. 4 units**

Term Typically Offered: SP

Prerequisite: CE 207 or CE 208; MATH 344; and ME 328.

Advanced strength of materials: behavior of disks, plates, and shells. Theory of elasticity. Energy methods. 3 lectures, 1 laboratory.

**ME 402. Orthopedic Biomechanics. 4 units**

Term Typically Offered: W

Prerequisite: ME 328.

Biomechanical analysis of the musculoskeletal system. Emphasis on the use of statics, dynamics, strength of materials, viscoelasticity, and poroelasticity to analyze the mechanical loads acting on human joints, the mechanical properties of tissues, and the design of artificial joints. Course offered in hybrid format with classroom-based and online learning. 3 lectures, 1 laboratory.

**ME 403. Access by Design: Introduction to Rehabilitation Engineering. 4 units**

Term Typically Offered: TBD

Prerequisite: CE 204 or CE 208; and ME 212.

Project-based course focused on the design and analysis of systems to assist people with disabilities. Workplace assistance, mobility aids, educational accommodations, assistive technology and adaptive sports. Universal design, empathy in design, the Americans with Disabilities Act, and the social model of disability. 3 lectures, 1 laboratory.

**ME 404. Applied Finite Element Analysis. 4 units**

Term Typically Offered: F, W

Prerequisite: BMED 410, and CE 207 or CE 208; or CE 406; or ME 328.

Finite element based solutions to engineering problems with an emphasis on elastostatic problems in structural mechanics. The power and pitfalls associated with the finite element method highlighted through practical modeling assignments. Introduces the use of commercial finite element codes. 3 lectures, 1 laboratory. Crosslisted as BMED/CE/ME 404.

**ME 405. Mechatronics. 4 units**

Term Typically Offered: F, W

Prerequisite: EE 321, EE 361, ME 305, and ME 329 (ME329 may be taken concurrently); or CPE 316 or CPE/EE 329 or CPE/EE 336.

Microprocessor applications in machine control and product design. Applied electronics. Drive technology; transducers and electromechanical systems. Real-time programming. Mechatronic design methodology. 3 lectures, 1 laboratory.

**ME 409. Interdisciplinary Study in Biomechanics. 4 units**

Term Typically Offered: SP

Prerequisite: BMED 410 and CE 207 or CE 208; or KINE 403; or ME 326.

Examination of human motion biomechanics. Experimental and analytical methods in motion analysis based on rigid body dynamics. Protocols for protection of human subjects in research. Hypothesis-driven research in interdisciplinary teams, including written proposal development and written/oral communication of results to a scientific audience. 1 lecture, 3 activities. Crosslisted as BMED/KINE/ME 409.

**ME 410. Experimental Methods in Mechanical Design I. 4 units**

Term Typically Offered: TBD

Prerequisite: ME 328. Recommended: ME 318.

Bonded resistance strain gages for static and dynamic measurements; rosettes, bridge circuits, lead wire effects, special gages. Data acquisition systems, and measurement of displacement, velocity, and acceleration. Photoelastic methods including birefringent coatings. Applications in mechanical design and metrology. 3 lectures, 1 laboratory.

**ME 412. Composite Materials Analysis and Design. 4 units**

Term Typically Offered: W

Prerequisite: AERO 331 or ME 328.

Behavior of unidirectional fiber composites. Properties of short-fiber composites, and orthotropic lamina. Analysis of laminated composites. Strength and hygrothermal behavior of composite materials. Structural optimization. 3 lectures, 1 laboratory.

**ME 415. Energy Conversion. 4 units**

Term Typically Offered: SP

Sustainability Related

Prerequisite: ME 302.

Engineering aspects of energy sources, conversion and storage. Topics selected from fossil fuel systems, nuclear power, thermoelectric systems, thermionic converters, fuel cells, magnetohydrodynamic generators, and geothermal, tidal, wind and ocean temperature energy conversion systems. 4 lectures.

**ME 416. Ground Vehicle Dynamics and Design. 4 units**

Term Typically Offered: SP

Prerequisite: ME 318 and ME 329.

Design of ground vehicles for directional stability and control. Tire mechanics and their effects on vehicle performance. Simulation of vehicle dynamics using digital computer. Synthesis of steering mechanism and suspension system. 3 lectures, 1 laboratory.

**ME 418. Implementation of Mechanical Controls. 4 units**

Term Typically Offered: F, W, SP

Prerequisite: ME 322.

Analysis, design, and implementation of automated controllers for mechanical systems. Experimental measurement of dynamic properties and creation of system models. Analysis and simulation of the effect of control strategies on system dynamics. Design of closed-loop control systems, including control of dynamic properties and implementation using common embedded computing hardware. Not open to students with credit in ME 419 or ME 422. 3 lectures, 1 laboratory.

**ME 419. Advanced Control Systems. 4 units**

Term Typically Offered: W, SP

Prerequisite: ME 322, ME 236.

Modeling and control of physical systems. Design of mechanical, hydraulic and electrical feedback control systems using time response, transfer function, frequency response, state space and computer simulation. Address state feedback, observability and controllability of multi-input, multi-output systems. Not open to students with credit in ME 418 or ME 422. 3 lectures, 1 laboratory.

**ME 422. Mechanical Control Systems. 4 units**

Term Typically Offered: F

Prerequisite: ME 318.

Modeling and control of physical systems. Design of mechanical, hydraulic and electrical systems using time response, frequency response, state space, and computer simulation. Not open to students with credit in ME 418 or ME 419. 3 lectures, 1 laboratory.

**ME 423. Robotics: Fundamentals and Applications. 4 units**

Term Typically Offered: W

Prerequisite: ME 326. Corequisite: ME 418, ME 419, or ME 422.

Introduction to robots and their types. Homogeneous transformations. Kinematic equations and their solutions. Motion trajectories, statics, dynamics, and control of robots. Robot programming. Actuators, sensors and vision systems. 3 lectures, 1 laboratory.

**ME 428. Senior Design Project I. 2 units**

Term Typically Offered: F, W, SP

Prerequisite: ME 329. Corequisite: ME 318; ME 343 or ME 350; and IME 141, IME 142, IME 143, IME 146, ME 161, or ITP 341.

First of three courses taken sequentially in component and system design using real-world problems. Small teams study and apply techniques of the engineering design process including problem definition, concept generation, feasibility studies and decision making. Practice of professional skills including written and oral communication, teaming, project management, societal responsibility and ethics. 2 laboratories.

**ME 429. Senior Design Project II. 2 units**

Term Typically Offered: F, W, SP

Prerequisite: ME 428.

Continuation of a project begun in ME 428. Activities focused on detail design, analysis and material procurement. 2 laboratories.

**ME 430. Senior Design Project III. 2 units**

Term Typically Offered: F, W, SP

Prerequisite: ME 429.

Completion of a project begun in ME 428 and continued in ME 429. Design verified through prototyping and testing. 2 laboratories.

**ME 434. Enhanced Oil Recovery. 4 units**

Term Typically Offered: TBD

Prerequisite: ME 302; ME 347; and ME 343 or ME 350.

Primary, secondary, and tertiary (enhanced) oil recovery methods. Waterflooding, polymerflooding, gas injection, steam injection, in-situ combustion, chemical flooding, miscible flooding. Performance calculations and computer applications in EOR. 4 lectures.

**ME 435. Drilling Engineering. 4 units**

Term Typically Offered: TBD

Prerequisite: ME 329, ME 347.

Theory and practice of oilwell planning, drilling, well logging, and completion applied to the development of new oil and gas production, from onshore and offshore fields. 4 lectures.

**ME 436. Petroleum Production Engineering. 4 units**

Term Typically Offered: TBD

Prerequisite: ME 329, ME 347.

Design and operation of surface and subsurface equipment required in oil production. Processes and systems involved are rod pumping, gas lifting, acidizing, hydraulic fracturing, fluid gathering and storage, separation of oil, gas, water and sediment from produced fluid. Includes equipment used in enhanced oil recovery processes. 4 lectures.

**ME 437. Nuclear Energy Power Generation. 4 units**

Term Typically Offered: F

Prerequisite: Junior standing; PHYS 132 or PHYS 142; and PHYS 133 or PHYS 143.

Operation of a nuclear electric generation station; includes reactor water chemistry, material science, electric science, mechanical science, civil engineering for the nuclear power plant engineers and digital process control systems. Field trip may be required. 4 lectures.

**ME 438. Nuclear Power Plant Design. 4 units**

Term Typically Offered: W

Prerequisite: ME 302.

Principal elements of pressurized water reactor nuclear power systems; overview of reactor physics, thermodynamics, and heat transfer; includes basic reactor physics, reactor heat generation, reactor plant systems, support systems, and reactor safety. Field trip may be required. 4 lectures.

**ME 439. Nuclear Power Plant Operations. 4 units**

Term Typically Offered: TBD

Prerequisite: ME 437 or ME 438.

Overview of mass, momentum and energy conversion related to nuclear power plants; includes coupled neutronic/thermal models to study plant operation semi-quantitatively achieving an integrated plant understanding. Content includes: Neutron power kinetics, Coupled neutronic/thermal hydraulic modeling, Quantitative transient modeling, demonstration transients. Field trip may be required. 4 lectures.

**ME 441. Single Track Vehicle Design. 4 units**

Term Typically Offered: W

Prerequisite: ME 326 and ME 329; or consent of instructor.

Design of single track vehicles, including handling characteristics, ergonomics and human power, strength and stiffness considerations, braking and suspension. Laboratory focus on designing a single track vehicle, including fabrication of a handling prototype. 3 lectures, 1 laboratory.

**ME 442. Design of Machinery. 4 units**

Term Typically Offered: F

Prerequisite: ME 212.

Graphical synthesis and analysis of mechanisms and machines. Analytical fundamentals for study of displacements, velocities, accelerations, and static and dynamic forces necessary for design of planar linkages and gearing systems. Creative design projects using software simulation tools. 3 lectures, 1 laboratory.

**ME 443. Turbomachinery. 4 units**

Term Typically Offered: SP

Prerequisite: MATH 344; ME 303; ME 347; and ME 343 or ME 350.

Performance characteristics of various types for liquids and for gases. Criteria for proper selection of type and main dimensions. Cavitation criteria. Gas turbine cycles and performance. Two-dimensional cascades. Axial flow turbines and compressors. Centrifugal compressors and radial-inflow turbines. 4 lectures.

**ME 444. Combustion Engine Design. 4 units**

Term Typically Offered: TBD

Prerequisite: ME 303; ME 347; and ME 343 or ME 350.

Application of design parameters to the various engine cycles. Aspects of the combustion processes. Emission regulation effects on engine design. Static and dynamic loading. 3 lectures, 1 laboratory.

**ME 448. Thermal System Design. 4 units**

Term Typically Offered: F, W, SP

Prerequisites: ME 303, ME 343, and ME 347.

Design of thermal systems. Engineering economics, thermal component sizing, and simulation techniques applied to the design and performance analysis of thermal systems. Not open to students with credit in ME 420. 3 lectures, 1 laboratory.

**ME 450. Solar Thermal Power Systems. 4 units**

Term Typically Offered: F

Sustainability Related

Prerequisite: ME 343 or ME 350. Recommended: ME 415.

High and intermediate temperature systems for conversion of solar energy to mechanical power and heat. Thermal energy storage and total thermal energy system design. 3 lectures, 1 laboratory.

**ME 451. Engineering, Design, and Social Justice. 4 units**

Term Typically Offered: SP

Prerequisite: Senior standing. Recommended: ME 234 or equivalent engineering design course; and completion of USCP.

Explores topics at the intersection of engineering design theories and efforts for social justice and equity. Critiques dominant engineering mindsets, examines design practices, and articulates ways engineers can develop equity-mindedness in their problem-solving. 4 lectures.

**ME 453. Trends and Opportunities in HVAC&R. 1 unit**

Term Typically Offered: SP

Sustainability Focused

Prerequisite: ME 302 or ENVE 304.

Overview of the roles of the Heating, Ventilating, Air-Conditioning and Refrigeration (HVAC&R) industry. Presentation of state-of-the-art HVAC&R systems, components and design solutions. Includes guest speakers from HVAC&R industry. 1 activity.

**ME 454. Benchmarking and Assessment of Building Energy Performance. 4 units**

Term Typically Offered: W

Sustainability Focused

Prerequisite: ME 343 or ME 350. Recommended: ME 359.

An introduction and study of building energy assessment principles and protocols for existing commercial buildings. Course topics include techniques of energy measurement and verification, energy metric comparison and analysis, and energy auditing. Field trip required. 3 lectures, 1 laboratory.

**ME 455. Introduction to Building Energy Modeling. 3 units**

Term Typically Offered: SP

Sustainability Focused

Prerequisite: ME 343 or ME 350. Recommended: ME 359.

Introduction to principles and practices of building energy modeling. Case studies using state of the art energy modeling computer software to simulate the energy use of buildings. Methods to reduce energy consumption of buildings. 2 lectures, 1 laboratory.

**ME 456. HVAC Air and Water Distribution System Design. 4 units**

Term Typically Offered: F

Prerequisite: ME 302, ME 347.

Air and water distribution components and systems and the design of these systems with applications to the heating, ventilating and air-conditioning (HVAC) industry. Course offered in hybrid format with classroom-based and online learning. 3 lectures, 1 laboratory.

**ME 457. Refrigeration Principles and Design. 4 units**

Term Typically Offered: SP

Prerequisite: ME 341; ME 343 or ME 350.

Basic engineering principles of refrigeration processes including: vapor compression cycles, multipressure systems, absorption systems, steam jet cooling, air cycles, and low temperature refrigeration. 3 lectures, 1 laboratory.

**ME 458. Building Heating and Cooling Loads. 4 units**

Term Typically Offered: F

Prerequisite: ME 303; and ME 343 or ME 350.

Building heating and cooling load calculations, estimating energy consumption and operating costs for heating, ventilating and air-conditioning system design and selection. 3 lectures, 1 laboratory.

**ME 459. HVAC Senior Design Project I. 3 units**

Term Typically Offered: W

Prerequisite: ME 456.

First quarter of a two quarter sequence. Team project work in designing heating, ventilating and air-conditioning (HVAC) systems. New developments, policies and practices in the HVAC industry. Professional ethics relevant for practicing engineers. 1 lecture, 2 laboratories.

**ME 460. HVAC Senior Design Project II. 2 units**

Term Typically Offered: SP

Prerequisite: ME 459.

Continuation of work begun in ME 459. Team project designing heating, ventilating and air-conditioning (HVAC) systems. 2 laboratories.

**ME 470. Selected Advanced Topics. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. The Class Schedule will list topic selected. Total credit limited to 12 units. 1 to 4 lectures.

**ME 471. Selected Advanced Laboratory. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. The Class Schedule will list topic selected. Total credit limited to 8 units. 1 to 4 laboratories.

**ME 488. Wind Energy Engineering. 4 units**

Term Typically Offered: W

Sustainability Focused

Prerequisite: ME 329, ME 347, ME 302.

Engineering aspects of windpower systems including mechanical design, support structure design, aerodynamic analysis, wind field analysis, system concepts and analysis, and economics. 4 lectures.

**ME 493. Cooperative Education Experience. 2 units**

Term Typically Offered: F, W, SP

CR/NC

Prerequisite: Sophomore standing and consent of instructor.

Part-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Credit/No Credit grading only. No major credit allowed; total credit limited to 6 units.

**ME 494. Cooperative Education Experience. 6 units**

Term Typically Offered: F, W, SP

CR/NC

Prerequisite: Sophomore standing and consent of instructor.

Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. Formal report and evaluation by work supervisor required. Credit/No Credit grading only. No major credit allowed; total credit limited to 18 units.

**ME 495. Cooperative Education Experience. 12 units**

Term Typically Offered: F, W, SP  
CR/NC

Prerequisite: Sophomore standing and consent of instructor.

Full-time work experience in business, industry, government, and other areas of student career interest. Positions are paid and usually require relocation and registration in course for two consecutive quarters. A more fully developed formal report and evaluation by work supervisor required. Credit/No Credit grading only. No major credit allowed; total credit limited to 24 units.

**ME 500. Individual Study. 1-4 units**

Term Typically Offered: F, W, SP

Prerequisite: Consent of department head, graduate advisor and supervising faculty member.

Advanced study planned and completed under the direction of a member of the department faculty. Open only to graduate students who have demonstrated ability to do independent work. Enrollment by petition. Total credit limited to 8 units.

**ME 501. Continuum Mechanics and Elasticity. 4 units**

Term Typically Offered: F

Prerequisite: Graduate standing.

Introduction to continuum mechanics. Kinematics, stress, and balance laws. Constitutive theory for isotropic and anisotropic solids and viscous fluids. Applications including design of beams and pressure vessels, stress concentrations, fiber-reinforced composites, and non-homogeneous biological materials. Course offered in hybrid format with classroom-based and online learning. 4 lectures. Crosslisted as CE 511/ME 501.

**ME 503. Inelastic Stress Analysis. 4 units**

Term Typically Offered: W

Prerequisite: ME 501 or CE 511.

Perfectly plastic and work hardening materials; von Mises and Tresca yield, isotropic and kinematic hardening flow rules, boundary-value problems. Finite elasticity: kinematics, Cauchy- and Green-elasticity, invariance, constraints, Neo-Hookean and Mooney-Rivlin materials, experimental approaches, non-uniqueness, anisotropy, residual stress, thermoelasticity, boundary-value problems. Course offered in hybrid format with classroom-based and online learning. 4 lectures. Crosslisted as CE 513/ME 503.

**ME 504. Finite Element Analysis. 4 units**

Term Typically Offered: SP

Prerequisite: CE/ME 404 and CE 511/ME 501 or consent of instructor.

Finite element theory and application with a focus on computer implementation of the method. Strong, weak and variational formulations, physical and isoparametric spaces, error estimates, numerical integration, finite element algorithms, and programming architecture. 3 lectures, 1 laboratory. Crosslisted as CE/ME 504.

**ME 506. System Dynamics. 4 units**

Term Typically Offered: SP

Prerequisite: Graduate standing or consent of instructor.

Unified approach for mathematical modeling and analysis of dynamic physical systems which may store energy in multiple energy domains. Emphasis on developing lumped-parameter linear system models from a set of primitive elements in a systematic manner. 4 lectures.

**ME 507. Mechanical Control System Design. 4 units**

Term Typically Offered: F, SP

Prerequisite: Graduate standing or consent of instructor.

Application of principles of high-level design to mechanical control system implementation. Use of modified state transition logic in conjunction with object-oriented programming as design methodology. Real-time programming using above techniques for control of mechanical systems. 3 lectures, 1 laboratory.

**ME 517. Advanced Vibrations. 4 units**

Term Typically Offered: SP

Prerequisite: ME 318, graduate standing or consent of instructor.

Vibration of complex engineering systems. Inertia and stiffness matrices. Natural frequencies and normal modes. Approximate solutions and computer techniques. Response to transient and periodic inputs. 3 lectures, 1 laboratory.

**ME 518. Machinery Vibration and Rotor Dynamics. 4 units**

Term Typically Offered: W

Prerequisite: ME 318, graduate standing or consent of instructor.

Vibrations relating to rotating machinery. Modeling of structural rotordynamic phenomena induced by shaft flexibility, bearings, and seals. Laboratory measurement of rotor system dynamic response and interpretation of machinery diagnostic information. Research project on a related topic. 3 lectures, 1 laboratory.

**ME 540. Viscous Flow. 4 units**

Term Typically Offered: W

Prerequisite: ME 347, MATH 344 and graduate standing or consent of instructor.

Introduction to tensor calculus and indicial notation. Development of Reynolds' Transport Theory. Special forms of the governing equations of fluid motion. Internal flows and other classical solutions to the Navier-Stokes equations. 4 lectures.

**ME 541. Advanced Thermodynamics. 4 units**

Term Typically Offered: TBD

Prerequisite: ME 303 and ME 347; ME 343 or ME 350; and graduate standing.

Selected modern applications of thermodynamics which may include topics from: 1) equilibrium and kinetics as applied to combustion and air pollution, analysis and evaluation of techniques used to predict properties of gases and liquids, and 2) improvement of modern thermodynamic cycles by second law analysis. 4 lectures.

**ME 542. Dynamics and Thermodynamics of Compressible Flow. 4 units**

Term Typically Offered: F

Prerequisite: MATH 244; ME 303; ME 347; ME 343 or ME 350; and graduate standing.

Control volume analysis of fluid-thermo equations for one-dimensional, compressible flow involving area change, normal shocks, friction, and heat transfer. Two-dimensional supersonic flow including linearization, method of characteristics, and oblique shocks. One-dimensional constant area, unsteady flow, 4 lectures.

**ME 552. Advanced Heat Transfer I. 4 units**

Term Typically Offered: W

Prerequisite: MATH 344; ME 347; ME 343 or ME 350; and graduate standing.

Advanced principles of heat transfer. Classical solution techniques to problems in conduction and/or radiation. 4 lectures.

**ME 553. Advanced Heat Transfer II. 4 units**

Term Typically Offered: F

Prerequisite: MATH 344; ME 347; ME 343 or ME 350; and graduate standing.

Advanced principles of heat transfer. Classical solution techniques to problems in convection. 4 lectures.

**ME 554. Computational Heat Transfer. 4 units**

Term Typically Offered: SP

Prerequisite: ME 347; ME 343 or ME 350; and graduate standing.

Recommended: MATH 418.

Numerical solutions of classical, industrial, and experimental problems in conduction, convection, and radiation heat transfer. 3 lectures, 1 laboratory.

**ME 563. Graduate Seminar. 1 unit**

Term Typically Offered: F

Prerequisite: Graduate standing in mechanical engineering program.

Current developments in mechanical engineering. Participation by graduate students, faculty and guests. 1 seminar.

**ME 570. Selected Advanced Topics. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Graduate standing or consent of instructor.

Directed group study of selected topics for advanced students. The Class Schedule will list topic selected. Total credit limited to 8 units; may be repeated in same term. 1 to 4 seminars.

**ME 571. Selected Advanced Laboratory. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Graduate standing or consent of instructor.

Directed group laboratory study of selected topics for advanced students. The Class Schedule will list topic selected. Total credit limited to 8 units; may be repeated in same term. 1 to 4 laboratories.

**ME 579. Fluid Power Control. 4 units**

Term Typically Offered: TBD

Prerequisite: ME 418 or ME 419 or ME 422.

Design, analysis, and control of fluid power systems. Analysis of fluid power system components such as valves, actuators, pumps and motors. System response and stability. Dynamic modeling and computer simulation 3 lectures, 1 laboratory.

**ME 599. Design Project (Thesis). 1-9 units**

Term Typically Offered: F, W, SP

Prerequisite: Graduate standing.

Each individual or group will be assigned a project for solution under faculty supervision as a requirement for the master's degree, culminating in a written report/thesis.