MECHANICAL ENGINEERING

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Academic Programs

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Mission Statement

To impart knowledge in the art and science of mechanical engineering through a comprehensive curriculum true to the traditional Cal Poly learn-by-doing philosophy that produces mechanical engineers of high ethics and skill, fully prepared for entry into industry, government, graduate school and private enterprise.

Program Educational Objectives

A mechanical engineering alumnus will:

1. Research, design, develop, test, evaluate, or implement engineering solutions to problems that are of a complexity encountered in professional practice.
2. Communicate and perform as an effective engineering professional in both individual and team-based project environments.
3. Recognize and determine the ethical implications and societal impacts of engineering solutions.

Program Description

The profession of mechanical engineering is directed toward the design, manufacture, and system integration of a very wide variety of equipment ranging from manufacturing machinery and power generation equipment to consumer goods. Of central concern to mechanical engineers is the sound application of basic principles of solid mechanics, fluid mechanics and thermal sciences in the design, manufacture, and application of this equipment. Mechanical Engineering graduates obtain employment primarily with manufacturers, energy companies, consultants, and government agencies. Types of work performed by graduates include product design, mechanical design, testing, engineering management, engineering sales, design of manufacturing systems, and development of maintenance procedures. Mechanical Engineering graduates also often enhance their careers through graduate study in engineering, and some students also study engineering to build a scientific and technical foundation as a prelude to enrollment in medical, law, and business schools.

The focus of the Cal Poly Mechanical Engineering program is on education based on our “learn by doing” educational philosophy. Thus, the curriculum includes a large number of hands-on laboratories, integration of design throughout, and a senior project requirement for all students. Students are enrolled in engineering laboratories in all years of the curriculum. The program is accredited by the Engineering Accreditation Commission of ABET, www.abet.org (http://www.abet.org).

The Mechanical Engineering Department is the home of the Donald E. Bently Center for Engineering Innovation. The center provides support for faculty, students, and visiting scholars for the advancement of research, education, and practice in mechanical engineering. A $6 million endowment to fund three professorships supports the center.

Upper division students in the General Concentration (Degree Requirements and Curriculum (http://catalog.calpoly.edu/collegesandprograms/collegeofengineering/mechanicalengineering(bsmechanicalengineering/generalconcentration))) can choose professional elective courses from such courses as turbomachinery, robotics, mechatronics, composite materials, rotor dynamics, advanced mechanics, solar systems, internal combustion engines, heat and mass transfer, and courses emphasizing the petroleum, air conditioning, ventilating, and refrigeration industries. Students in the Mechatronics Concentration (Degree Requirements and Curriculum (http://catalog.calpoly.edu/collegesandprograms/collegeofengineering/mechanicalengineering(bsmechanicalengineering/mechatronicsconcentration))) are prepared for professional practice in the design of “intelligent” products for use in factory automation, robotics, hybrid vehicles, alternative energy, and many other fields. The HVAC&R Concentration (Degree Requirements and Curriculum (http://catalog.calpoly.edu/collegesandprograms/collegeofengineering/mechanicalengineering(bsmechanicalengineering/hvacrconcentration))) prepares students for careers in the heating, ventilating, air-conditioning and refrigeration (HVAC&R) industry, with a focus on the design of mechanical systems for commercial and industrial buildings. Manufacturing Concentration (Degree Requirements and Curriculum (http://catalog.calpoly.edu/collegesandprograms/collegeofengineering/mechanicalengineering(bsmechanicalengineering/manufacturingconcentration))) students focus on fabrication processes, preparing them for careers designing or manufacturing a wide variety of consumer and industrial products. The Energy Resources Concentration (Degree Requirements and Curriculum (http://catalog.calpoly.edu/collegesandprograms/collegeofengineering/mechanicalengineering/(bsmechanicalengineering/energyresourcesconcentration))) prepares students for careers in renewable and nonrenewable energy companies producing electrical power, with the focus on the design, manufacture, and system integration of power and fuel plants.

There are several organized student clubs associated with the Mechanical Engineering Department, including national honor societies and student chapters of professional societies. Each of these clubs offers students active programs and leadership activities.

Undergraduate Program

BS Mechanical Engineering

The profession of mechanical engineering is directed toward the design, manufacture, and system integration of a very wide variety of equipment ranging from manufacturing machinery and power generation equipment to consumer goods.

Concentrations

- General Concentration
- Energy Resources Concentration
- Heating, Ventilating, Air-Conditioning and Refrigerating Concentration (HVAC&R)
- Mechatronics Concentration
- Manufacturing Concentration
Graduate Program
MS Mechanical Engineering

The masters program of the Mechanical Engineering department at Cal Poly is designed to prepare its graduates with skill and knowledge to be able to work as an engineer in research and development, analysis, or design of products and systems, or to continue toward a PhD degree from other institutions. Due to the nature of the masters degree, students can select an area of emphasis based on their interest, or alternately, choose courses in a variety of different areas that gives them significant breath of knowledge. At Cal Poly, masters degree candidates can select a thesis option or a non-thesis option. The thesis option gives the candidates a more thorough knowledge in the area in which they do their research. The non-thesis option gives the candidates a more diverse knowledge from additional courses.

Prerequisites
For admission as a classified graduate student, in addition to the University requirements, an applicant should hold a BS degree in Mechanical Engineering with a grade point average of 3.0 or better. Other closely related majors may be accepted as conditionally classified graduate students if they have had an adequate number of prerequisite classes to successfully fulfill the requirements. Up to 12 units of remedial courses may be taken at Cal Poly. For additional information on University requirements, please refer to the Graduate Programs (http://catalog.calpoly.edu/graduateeducation) of this catalog.

Two program options are available:

Thesis option. 36 units of advisor-approved coursework, 9 units of thesis research/design, and an oral thesis defense examination.

Non-thesis option. 45 units of advisor-approved coursework and a written comprehensive examination.

Blended BS + MS Mechanical Engineering Program

A blended program provides an accelerated route to a graduate professional degree, with simultaneous conferring of both Bachelor’s and Master’s degrees. Students in the blended program are provided a seamless process whereby they can progress from undergraduate to graduate status. Up to 8 units of technical electives (400-level or higher) that were used in meeting the undergraduate degree requirements can also be used for credit toward meeting the graduate degree requirements.

Eligibility

Majors that are eligible for the blended program are:

- BS Aerospace Engineering
- BS Mechanical Engineering

Participation in a blended program is based upon prior academic performance and other measures of professional promise. Refer to Graduate Education (http://catalog.calpoly.edu/graduateeducation/#graduateandpostbaccalaureateadmissionrequirements) for more information and for the minimum criteria required to be eligible for a blended program at Cal Poly. Contact the Graduate Program Coordinator in the Mechanical Engineering department for any additional eligibility criteria.

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: FW,SPSU
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
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. 3 lectures. Crosslisted as HNRS/ME 211.
ME 212. Engineering Dynamics. 3 units
Term Typically Offered: F, W, SP
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. 3 lectures.

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: F, W, SP
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
Prerequisite: Sophomore standing.
General approach to the meaning of engineering design. Conceptual blocks, creativity, design process, design considerations and elements. 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.
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.
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
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. 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
Prerequisite: ME 212 and PHYS 132.
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
Prerequisite: ME 302.
Vapor and gas power cycles, refrigeration cycles, thermodynamic relations, psychrometrics, and chemical reactions. 3 lectures.

ME 305. Introduction to Mechatronics. 4 units
Term Typically Offered: F, W
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 318. Mechanical Vibrations. 4 units
Term Typically Offered: F, W, SP
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 320. Consumer Energy Guide. 4 units  
GE Area B7; GE Area F  
Term Typically Offered: TBD  
Prerequisite: Junior standing; completion of GE Area A with grades of C- or better; completion of GE Area B1 with a grade of C- or better in at least one of the courses; and completion of GE Areas B2, B3, and B4.  
Interdisciplinary connection of everyday consumer decisions with energy costs, security, and global warming. Energy consumption by home appliances and automobiles. Methods to reduce the individual ‘energy footprint’ with renewable energy, purchasing carbon offsets, and behavioral modifications. 4 lectures. Fulfills GE Area B7 or GE Area F.

ME 322. Introduction to System Dynamics. 4 units  
Term Typically Offered: F, W  
Prerequisites: 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 323. Everything is Designed: The Invention and Evolution of Products. 4 units  
GE Area B7; GE Area F  
Term Typically Offered: W  
Prerequisite: Junior standing; completion of GE Area A with grades of C- or better; completion of GE Area B1 with a grade of C- or better in at least one of the courses; and completion of GE Areas B2, B3, and B4.  
Investigation of engineering product designs, including social, environmental, and technological influences. Incorporation of engineering design tools to develop a product using creative methods and design methodology. Exploration of creative problem solving methods and barriers to creativity. 4 lectures. Fulfills GE Area B7 or GE Area F.

ME 326. Intermediate Dynamics. 4 units  
Term Typically Offered: F, W, SP  
Prerequisite: ME 212; 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; CSC 231 or CSC 234; MATE 210; ME 212; and ME 251. Corequisite: IME 141 or ITP 341.  
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. 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, SP  
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 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 350. Heat Transfer. 4 units  
Term Typically Offered: F, W, SP  
Prerequisite: CPE/CSC 101 or CSC 231 or CSC 234; MATE 360 and MATE 380, or ME 236 and ME 302 and ME 341.  
Basic principles of heat transfer by conduction and convection. Laboratory experiments to characterize thermodynamic material properties, energy conversion processes, thermodynamic cycles, and performance of heat transfer equipment. Not open to students with credit in ME 343. 3 lectures, 1 laboratory.

ME 359. Fundamentals of HVAC Systems. 4 units  
Term Typically Offered: F  
Corequisite: ME 302.  
Fundamentals of heating, ventilating and air-conditioning (HVAC) systems, human comfort and indoor air quality, primary and secondary systems and components. 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: F  
Prerequisite: CE 207, MATH 344, ME 328 or consent of instructor.  
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: SP  
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. 3 lectures, 1 laboratory.
ME 404. Applied Finite Element Analysis. 4 units
Term Typically Offered: F, W, SP
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: W, SP
Prerequisite: EE 321, EE 361, ME 305, and ME 329 (ME329 may be taken concurrently); CPE 316 or CPE/EE 329 or CPE/EE 336.

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. 4 units

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 406. Energy Conversion. 4 units
Term Typically Offered: SP
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 units.
ME 428. Senior Design Project I. 2 units
Term Typically Offered: F, W, SP
Prerequisite: ME 329. Corequisite: ME 318 and ME 350.

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 431. Mechanical Design Techniques. 4 units
Term Typically Offered: TBD
Prerequisite: ME 329.

Comprehensive study of various design methods and techniques. Techniques used to explore various structural concepts such as prestressing, shaping, sizing, etc. Simulation of systems using digital computer. Design criteria identification of design parameters and constraints. 3 lectures, 1 laboratory.

ME 434. Enhanced Oil Recovery. 4 units
Term Typically Offered: W
Prerequisite: ME 302, ME 347, and 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: F
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: SP
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 or senior standing in the College of Engineering, ME 302, and PHYS 133.

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 and ME 341.

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: SP
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 318, 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 312.

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 350.

ME 444. Combustion Engine Design. 4 units
Term Typically Offered: W
Prerequisite: ME 303, ME 347, and 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 450. Solar Thermal Power Systems. 4 units
Term Typically Offered: W
Prerequisite: 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 453. Trends and Opportunities in HVAC&R. 1 unit
Term Typically Offered: SP
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
Prerequisite: 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
Prerequisite: 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. 3 lectures, 1 laboratory.

ME 457. Refrigeration Principles and Design. 4 units
Term Typically Offered: SP
Prerequisite: ME 341 and 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 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, ME 458.
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: SP
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
CR/NC
Term Typically Offered: F, W, SP
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
CR/NC
Term Typically Offered: F, W, SP
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
CR/NC
Term Typically Offered: F, W, SP
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. 1-3 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.

ME 501. Continuum Mechanics and Elasticity. 4 units
Term Typically Offered: TBD
Prerequisite: Graduate standing.


ME 503. Inelastic Stress Analysis. 4 units
Term Typically Offered: TBD
Prerequisite: ME 501 or CE 511.


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
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 rotodynamic 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, ME 347, 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 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: F
Prerequisite: MATH 344, ME 347, 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: W
Prerequisite: MATH 344, ME 347, 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: MATH 418, ME 347, ME 350, and graduate standing.

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

ME 556. Advanced Heat Transfer III. 4 units
Term Typically Offered: SP
Prerequisite: ME 347 or FPE 502; and ME 350.

Advanced principles of heat transfer. Classical solution techniques to problems in radiation with applications related to the role of radiation heat transfer in the development of fire in buildings. 4 lectures. Crosslisted as FPE/ME 556.

ME 559. Fluid Power Control. 4 units
Term Typically Offered: TBD
Prerequisite: 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 559. 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.

ME 563. Graduate Seminar. 1 unit
Term Typically Offered: W
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 of 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.