Mechanical Engineering

Engineering Bldg. (13), Room 254
Phone: 805.756.1334
www.me.calpoly.edu/

Department Chair: James Meagher

College of Engineering Advising Center
Engineering South (40), Room 114
Phone: 805.756.1461

Academic Programs

Program name                  Program type
Mechanical Engineering        BS, MS

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 an important 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.

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, alternate 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)) graduates will be uniquely suited for career paths where the engineer blends design and manufacturing. These skills are needed at all modern product development companies.

There are six organized student clubs associated with the Mechanical Engineering Department. These are student chapters of the American Society of Mechanical Engineers, Society of Petroleum Engineers, Society of Automotive Engineers, American Society of Heating, Refrigerating and Air Conditioning Engineers, Alternative Energy Club, and the Pi Tau Sigma honorary society. All of these clubs offer students active programs in professional 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
- 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 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 breadth of knowledge. At Cal Poly, masters degree candidates can also 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.

General Characteristics

The Master of Science in Mechanical Engineering prepares students to design and develop advanced products and systems; to conduct research and analysis; to work in industry; or to continue study toward a Ph.D. Graduate students enjoy the same flavor of learn-by-doing as other Cal Poly students. Students may choose their technical electives in the area that interests them, including thermo-sciences, controls and robotics, mechanics and stress analysis, composite materials.

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. Other closely related majors may be accepted as conditionally classified graduate students until they take necessary prerequisite mechanical engineering courses as approved by the graduate advisor. 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

The blended program provides motivated students with an accelerated route to the MS Mechanical Engineering, with simultaneous conferring of both bachelor’s and master’s degrees. Students in the blended program are provided with a seamless process whereby they can progress from undergraduate to graduate status. Up to two technical electives can be taken as an undergraduate and counted towards the master’s degree.

Eligibility

Students majoring in BS Mechanical Engineering may be eligible to pursue the blended program toward the MS Mechanical Engineering (http://catalog.calpoly.edu/collegesandprograms/collegeofengineering/mechanicalengineering/msmechanicalengineering). Participation in the program is based on prior academic performance and other measures of professional promise, with a minimum GPA of 2.5 required, 3.0 recommended. Students are recommended for admission by a faculty committee. Please see Graduate Education (https://nextcatalog-admin.calpoly.edu/graduateeducation/#generalpoliciesgoverninggraduatedestext) for eligibility criteria.

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.

ME Courses

**ME 128. Introduction to Mechanical Engineering I.** 1 unit
Term Typically Offered: F
Prerequisite: Mechanical Engineering student; first quarter of freshman year.

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 first quarter cornerstone service learning project. 1 laboratory. Formerly ME 134.

**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: ME 163.

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. Includes continuation of cornerstone service learning design project. 1 laboratory. Formerly ME 151.

**ME 130. Introduction to Mechanical Engineering III.** 1 unit
Term Typically Offered: SP
Prerequisite: ME 129; Mechanical Engineering student; third quarter of freshman year.

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. Conclusion of cornerstone service learning project. 1 laboratory. Formerly ME 152.

**ME 163. Freshmen Orientation to Mechanical Engineering.** 1 unit
Term Typically Offered: W
Concurrent: ME 129.

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. 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.
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: ME 130 or ME 228 (may be taken concurrently).  
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: ENGL 134, CHEM  
125, PHYS 131.  
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.  
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  
and inertia properties. Emphasis of group work and peer review in  
the production of parts for assemblies. 1 lecture, 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 Schedule of Classes will  
list title 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 Schedule  
of Classes will list title selected. Total credit limited to 4 units. 1 to 2  
laboratories.

ME 302. Thermodynamics I. 3 units  
Term Typically Offered: F, W, SP  
Prerequisite: PHYS 132; ME 212 or CHEM 128.  
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 321 and EE 361, or consent of instructor.  
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 326, 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  
Term Typically Offered: SP  
Prerequisite: Open to undergraduate students and consent of  
instructor.  
Directed group study of selected topics. The Schedule of Classes will  
list title selected. Total credit limited to 8 units. 1 to 4 lectures.
ME 326. Intermediate Dynamics. 4 units  
Term Typically Offered: F, W, SP  
Prerequisite: MATH 244 (or concurrent), ME 212, CSC 231 or CSC 234.  
Continuation of ME 212. Additional analysis of planar motion of rigid bodies with particular attention to the kinematics of mechanisms. Rotating reference frames. Introduction to three dimensional dynamics. Dynamic simulation of mechanisms. 3 lectures, 1 activity.

ME 328. Introduction to Design. 4 units  
Term Typically Offered: F, W, SP  
Prerequisite: BMED 212 or ME 234; CE 207; CSC 231 or CSC 234; ENGL 149; MATE 210; ME 212; and ME 251. Concurrent: IME 141 or IT 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. Intermediate 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: ME 212 or ARCE 225.  
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 346. Thermal Science Laboratory. 1 unit  
Term Typically Offered: F, W, SP  
Prerequisite: ME 303 and ME 343.  
Heat transfer and thermodynamic experiments covering combined free convection and radiation, transient conduction, energy conversion, heat exchanger, polytropic blowdown, steam turbine, and refrigeration cycles. 1 laboratory.

ME 347. Fluid Mechanics II. 4 units  
Term Typically Offered: F, W, SP  
Prerequisite: ME 236, ME 341, ME 302 or consent of instructor.  
Conservation equations of fluid dynamics. Viscous flow, boundary layer concepts, lift and drag, compressible flow, turbomachinery. Laboratory measurement of turbomachinery 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 380 or ME 302; ME 236; 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: W  
Prerequisite: 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: W  
Prerequisite: ME 328 or consent of instructor.  
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: W  
Prerequisite: BMED 410 and CE 207; 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: ME 305 and ME 329 (may be taken concurrently); or CPE/EE 329.  
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 410. Experimental Methods in Mechanical Design I. 4 units  
Term Typically Offered: SP  
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: SP
Prerequisite: AERO 331 or ME 328.

ME 415. Energy Conversion. 4 units
Term Typically Offered: W
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: F
Prerequisite: ME 318, ME 328.
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 420. Thermal System Design. 4 units
Term Typically Offered: F, W, SP
Prerequisite: ME 303; ME 347; and ME 343 or ME 350.
Radiation and combined mode heat transfer. Design of thermal systems. Engineering economics, thermal component sizing, and steady-state simulation techniques applied to the design and performance analysis of thermal systems. Not open to students with credit in ME 440. 3 lectures, 1 laboratory.

ME 422. Mechanical Control Systems. 4 units
Term Typically Offered: F, W, SP
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. 3 lectures, 1 laboratory.

ME 423. Robotics: Fundamentals and Applications. 4 units
Term Typically Offered: F, SP
Prerequisite: ME 326, ME 422.

ME 428. Senior Design Project I. 3 units
Term Typically Offered: F, W, SP
Prerequisite: ME 329. Corequisite: ME 318 and ME 350 (formerly ME 343).
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. 1 lecture, 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. 1 unit
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. 1 laboratory.

ME 431. Mechanical Design Techniques. 4 units
Term Typically Offered: F
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 432. Petroleum Reservoir Engineering. 4 units
Term Typically Offered: W
Prerequisite: ME 341.
Types of reservoirs and reservoir rocks. Measurement and interpretation of physical properties of reservoir rocks and fluids: porosity, permeability, compressibility, electrical resistivity, fluid saturation, viscosity, solution gas and PVT properties of reservoir fluids. Introduction to flow in porous media, reserve calculations for different reservoirs and computer applications. 3 lectures, 1 laboratory.

ME 434. Enhanced Oil Recovery. 4 units
Term Typically Offered: W
Prerequisite: ME 302, ME 347, and ME 350 (formerly ME 343).
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 440. Thermal System Design and Optimization. 4 units
Term Typically Offered: F, W
Prerequisite: ME 303; ME 347; and ME 343.
Design and optimization of thermal systems. Engineering economics, thermal component sizing, steady-state simulation, and optimization 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 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 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 350 (formerly ME 343).

ME 444. Combustion Engine Design. 4 units
Term Typically Offered: W
Prerequisite: ME 303, ME 347, and ME 350 (formerly ME 343).
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 343. 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 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 (formerly ME 343).
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 (formerly ME 343).
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 Schedule of Classes will list title 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 Schedule of Classes will list title selected. Total credit limited to 8 units. 1 to 4 laboratories.

ME 486. 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: F  
Prerequisite: Graduate standing.  

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

ME 504. Finite Element Analysis. 4 units  
Term Typically Offered: SP  
Prerequisite: CE/ME 404 and CE 511 or ME 501 or consent of instructor.  
Linear finite element theory and analysis. Strong, weak and variational formulations. Physical and isoparametric spaces. Error estimates and numerical integration. Development of finite element algorithms. Use of commercial finite element codes to illustrate course concepts including modeling issues and limitations. 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 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: F
Prerequisite: ME 303, ME 347, ME 350 (formerly ME 343), 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 (formerly ME 343), 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 (formerly ME 343), 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 (formerly ME 343), 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 (formerly ME 343), 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 (formerly ME 343).

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 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 Schedule of Classes will list topic selected. Total credit limited to 8 units; may be repeated in same term. 1-4 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 Schedule of Classes will list topic selected. Total credit limited to 8 units; may be repeated in same term. 1-4 laboratories.

ME 579. Fluid Power Control. 4 units
Term Typically Offered: F
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 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.