MECHANICAL ENGINEERING

<http://www.csupomona.edu/~me>

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Mechanical engineering has traditionally been one of the most general branches of engineering. A mechanical engineer requires a broad knowledge in many fields: mechanics, thermal/fluid sciences, design, machinery and instrumentation, energy, control system theory and more. The breadth and flexibility of a mechanical engineer's education provides a wide choice of careers and allows movement into a variety of engineering areas to better meet the challenges of a changing world. The accredited mechanical engineering curriculum permits students to explore different fields, specializing in one or more of them as they find their true interests. In particular, the curriculum is designed to:

- provide a solid background in mathematics and science coupled with an applications-oriented polytechnic approach in the presentation of engineering course material;
- provide a comprehensive program of general education courses that will provide students with the necessary background to understand the economic, environmental, ethical, political, societal and cultural impact of their engineering solutions and decisions;
- develop good written and verbal communication skills;
- encourage lifelong learning in their chosen field;
- provide the necessary tools and background to become a professional engineer; and
- provide a learning environment enhanced by faculty with professional engineering experience whose prime focus is teaching.

During the junior and senior years, approved technical electives packages in various areas of Mechanical Engineering are available to students. These areas are Energy (Thermal/Fluid Sciences), and Mechanical Design and Analysis Those students who wish to further their knowledge in these specific areas may take all of their technical elective units from any one of these packages. These students will be awarded a certificate attesting to the fact that they have successfully completed the courses in a particular area. Others, who would like to have a more general knowledge of the Mechanical Engineering field, can choose their technical elective courses from any combination of the packages.

Principles developed in the classroom are applied to the operation of heat transfer equipment, fluid handling equipment, energy, energy systems, environmental control systems, internal and external combustion engines, mechanical systems, and testing of engineering materials.

Students desiring to major in Mechanical Engineering should have a particularly high aptitude for science and mathematics, and incoming freshmen should have taken substantial college preparatory courses in these disciplines in high school. Incoming transfer students should have completed at least one year of college calculus and one year of college physics (with laboratory) prior to beginning the program at Cal Poly Pomona. The community college student planning to transfer into this department should consult a school counselor or this department to determine which courses meet the program requirements.

Mechanical engineers work in industry, business, government, universities, and in the professions of law and medicine. They are involved in research, development, design, testing, production, operation, maintenance, marketing, sales, administration, management, and education. Graduates of the program are prepared to do productive work in their first jobs as well as to grow with their profession throughout their engineering career. The curriculum is designed to prepare a student for direct entry into the engineering profession and for graduate school.

Mechanical engineering students are encouraged to become active in the student chapters of the American Society of Mechanical Engineers, the Society of Automotive Engineers, the American Society of Heating, Refrigeration and Air Conditioning Engineers, and The Association of Energy Engineers. Qualified students are invited to join the student chapter of Pi Tau Sigma, the mechanical engineering honor society.

CORE COURSES FOR MAJOR

Required of all students. A 2.0 cumulative GPA is required in core courses in order to receive a degree in the major.

Mechanical Engineering Orientation	ME	100L	(1)
Vector Statics	ME	214	(3)
Vector Dynamics	ME	215	(4)
Strength of Materials	ME	218	(3)
Strength of Materials	ME	219	(3)
Strength of Materials Laboratory	ME	220L	(1)
Mechanics Laboratory	ME	224L	(1)
Engineering Digital Computations	ME	232/A	(2/1)
Introduction to Mechanical Design	ME	233/L	(3/1)
Thermodynamics	ME	301	(4)
Thermodynamics	ME	302	(4)
Fluid Mechanics	ME	311	(3)
Fluid Mechanics	ME	312	(3)
Fluid Mechanics Laboratory	ME	313L	(1)
Engineering Materials	ME	315	(4)
Intermediate Dynamics	ME	316	(3)
Stress Analysis	ME	319	(4)
Machine Design	ME	325/L	(3/1)
Modeling and Simulation of Dynamic Systems	ME	340	(3)
Materials Science and Selection Laboratory	ME	350L	(1)
Finite Element Analysis	ME	406/A	(3/1)
Air Conditioning	ME	418/L	(3/1)
or Thermal Systems Design	ME	427	(4)
Heat Transfer	ME	415	(4)
Theory and Design for Mechanical Measurements	ME	435/L	(3/1)
Control of Mechanical Systems	ME	439/L	(3/1)
Analytic Geometry and Calculus II	MAT	115	(4)
Analytic Geometry and Calculus III	MAT	116	(4)
Calculus of Several Variables I	MAT	214	(3)
Calculus of Several Variables II	MAT	215	(3)
Linear Algebra and Differential Equations	MAT	224	(4)
General Physics	PHY	131/131L	(3/1)
General Physics	PHY	133/133L	(3/1)

TECHNICAL ELECTIVE AREAS AND COURSES (13 units)

Required of all students

A total of 13 units of course work is dedicated to enhancing students' knowledge of a particular area of Mechanical Engineering or their general knowledge of the field. Courses in two areas are offered as packages whereby the student may select all of the 13 units from the courses in one of these areas. Upon graduation, students may request a

certificate issued by the department testifying that they have successfully completed the courses in the particular package.

Students who wish to minor in a particular area of engineering may petition to have the required courses for the minor accepted as technical electives. ME 499 and graduate level courses are also acceptable as technical electives with prior approval.

Alternatively, students may choose to select a mixture of courses from the two areas as their technical elective courses. No more than four units of the total of 13 units of technical electives may be taken outside of the Mechanical Engineering Department. A maximum of 3 units of approved lower division courses may be taken for technical elective credit.

The courses in the two areas are as follows:

Energy (Thermal/Fluid Sciences)

Energy Management	ME	306	(4)
Alternative Energy Systems	ME	307	(4)
Acoustics and Noise Control	ME	405	(4)
Solar Thermal Engineering	ME	407/L	(3/1)
Nuclear Engineering	ME	408	(4)
Kinetic Theory/Statistical Thermodynamics	ME	409	(4)
Heat Power	ME	411/L	(3/1)
Internal Combustion Engines	ME	412/L	(3/1)
Building Energy Calculations	ME	417/L	(3/1)
Air Conditioning**	ME	418/L	(3/1)
Thermal Systems Design**	ME	427	(4)

**Cannot satisfy a technical elective requirement if being used to satisfy a core requirement.

Mechanical Design and Analysis

Engineering Graphics II/Laboratory	MFE	226/L	(2/1)
Advanced Machine Design/Laboratory	ME	425/L	(3/1)
Acoustics and Noise Control	ME	405	(4)
Mechanical Vibrations	ME	413	(4)
Dynamics of Machinery	ME	421	(4)

SUPPORT COURSES

General Chemistry I* (B2)	CHM	121	(3)
General Chemistry I Lab* (B2)	CHM	121L	(1)
General Chemistry II	CHM	122	(3)
General Chemistry II Lab* (B2)	CHM	122L	(1)
Advocacy and Argument* (A2)	COM	204	(4)
Principles of Economics* (D2)	EC	201 or 202	(4)
Elements of Electrical Engineering.	ECE	231, 231L	(4)
Ethical Considerations in Technology and Applied Science* (C4)	EGR	402	(4)
Asset Allocation in Technical Decision Making* (D4)	EGR	403	(4)
Project Design Principles and Applications* (B4)	EGR	481, 482	(4)
Analytic Geometry and Calculus I* (B1)	MAT	114	(4)
Engineering Graphics I	MFE	126/L	(2/1)
Manufacturing Systems Processes	MFE	201/L	(3/1)

*Courses may be used to satisfy GE areas indicated. If these course are not used to satisfy GE, the total units to degree may be more than 198 units.

GENERAL EDUCATION COURSES

An alternate pattern from that listed here for partial fulfillment of Areas A, C, and D available for students in this major is the Interdisciplinary General Education (IGE) Program. Please see the description of IGE elsewhere in this catalog.

Area A (12 units)

1. Written Communication
2. Oral Communication
3. Critical Thinking

Area B (16 units)

1. Math/Quantitative Reasoning
2. Physical Science
3. Biological Science
4. Science and Technology Synthesis

Area C (16 units)

1. Fine and Performing Arts
2. Philosophy and Civilization
3. Literature and Foreign Languages
4. Humanities Synthesis

Area D (20 units)

1a. and 1b. U.S. History, Constitution, and American Ideals
2. History, Economics, and Political Science
3. Sociology, Anthropology, Ethnic, and Gender Studies
4. Social Science Synthesis

Area E (4 units)

Lifelong Understanding and Self-development

COURSE DESCRIPTIONS

Lecture and laboratory courses listed together are to be taken concurrently.

ME 100L Mechanical Engineering Orientation (1)

Introduction to the resources and facilities of the mechanical engineering department. An overview of career opportunities and introspection about mechanical engineering. Various forms of engineering communication including report writing, graphical presentations and problem-solving format. Becoming conversant with unit systems and dimensional analysis. Introduction to engineering design. 1 three-hour laboratory.

ME 214 Vector Statics (3)

Two and three dimensional equilibrium of particles and rigid bodies including frames, machine and trusses employing vector algebra. Principles of friction, centroids and center of gravity, moments of inertia for areas. 3 lectures/problem-solving. Prerequisite: ENG 104. Corequisites: MAT 115 and (for ME majors only) ME 224L.

ME 215 Vector Dynamics (4)

Vector mathematics of absolute and relative motion of particles and the planar motion of rigid bodies in an inertial reference frame. Newton's laws of motion, work-energy, impulse-momentum, mass moment of inertia. 4 lectures/problem-solving. Prerequisite: C– or better in MAT 115 and ME 214.

ME 217 Mechanics for ECE Majors (4)

A basic course in statics and dynamics for ECE majors. Selected topics from ME 214 and ME 215 specific to electrical engineering. 4 lectures/problem-solving. Prerequisites: C– or better in PHY 131 and MAT 115.

ME 218 Strength of Materials (3)

Plane stress and strain. Principal stresses and strains, Mohr's Circle. Properties of materials, stress strain diagrams. Generalized Hooke's Law for isotopic materials. Design loads, working stresses, and factor of safety. Statically indeterminate axially-loaded members. Torsional shearing stresses and displacements. Combined axial and torsional loads. Flexural and transverse shear stresses. Shear and moment diagrams. Beams of two materials. Thin-walled pressure vessels. 3 lectures/problem-solving. Prerequisite: C– or better in ME 214.

ME 219 Strength of Materials (3)

Deflection and slope of beams by double integration, singularity functions, superposition and energy methods. Statically indeterminate beams. Column analysis with centric and eccentric loads. Combined axial, torsional, and flexural stresses. Thick-walled pressure vessels. 3 lectures/problem-solving. Prerequisite: C– or better in ME 218 and ME 224L.

ME 220L Strength of Materials Laboratory (1)

Standard physical tests of engineering materials including torsion, tension, compression and bending. Experimental stress analysis using strain gages. 1 three-hour laboratory. Corequisite: ME 219. Prerequisites: C– or better in ME 231. A score of 6 or better on GWT.

ME 224L Mechanics Laboratory (1)

Spatial visualization, free-body diagramming, vector manipulation, force transmission and distribution, force balances, force-moment equivalences, practice in recognizing and developing problem-solving techniques. 1 three-hour laboratory. Corequisite: ME 214

ME 231 Mechanical Engineering Communications (4)

The mechanics of effective engineering communications. Composition and style of various types of written and oral presentations of technical information. Critical analysis of specifications related to the design, test and performance of components and systems typically found in the field of mechanical engineering. 4 lectures/problem-solving. Prerequisite: C– or better in ENG 103 or 104.

ME 232/A Engineering Digital Computations (2/1)

Problems involving basic computational methods including elementary concepts of digital computer programming. Proficiency will be gained in writing computer programs. Assignments include the use of the computer facilities. 2 lectures/problem-solving and 1 two-hour activity. Corequisite: MAT 114.

ME 233/L Introduction to Mechanical Design (3/1)

Introduction to machine and product design techniques and the design and selection of power transmission elements such as couplings; U-joints; roller and silent chains; V, flat and gear belts; gears and gear transmissions; friction drives; electric motors. Introduction to shaft design, bearings and attachments. The execution of layouts and engineering specifications for manufacture. 3 lectures/problem-solving and 1 three-hour laboratory. Prerequisite: MFE 126/L, C– or better in ME 214 and ME 224L.

ME 299/299A/299L Special Topics for Lower Division Students (1–4)

Group study of a selected topic, the title to be specified in advance. Total credit limited to 8 units, with a maximum of 4 units per quarter. Instruction is by lecture, laboratory, or a combination.

ME 301 Thermodynamics (4)

Thermodynamic properties and processes; equations of state; tables and charts of thermodynamic properties; work and heat, the first law of thermodynamics and first law properties; the second law of thermodynamics and entropy; carnot cycle, simple Brayton cycle, 4 lectures/problem-solving. Prerequisite: C– or better in ENG 104 and ME 214.

ME 302 Thermodynamics (4)

Rankine cycle and its variations; refrigeration cycles; advanced Brayton cycle and Otto and Diesel cycles; mixtures of ideal gases; Maxwell relations; chemical thermodynamics. 4 lectures/problem-solving. Prerequisites: C– or better in ME 301.

ME 306 Energy Management (4)

Energy system modeling; forecasting techniques; analysis of energy requirements; energy audits; net energy analysis; conservation strategies; energy, environment and economics interface; role of energy management and case studies. 4 lectures/problem-solving. Prerequisites: C– or better in ME 301 or equivalent.

ME 307 Alternative Energy Systems (4)

Analysis and synthesis of energy systems; fossil fuel systems; viable alternative energy sources, solar, geothermal, wind, biomass, hydro and ocean resources; conversion, storage, and distribution. Environmental impact and economics of alternative systems. Synthesis of energy system components. 4 lectures/problem-solving. Prerequisites: C– or better in ME 301.

ME 311 Fluid Mechanics (3)

Analysis and problems dealing with properties and behavior of fluids at rest and in motion. Fundamental concepts; fluid statics; transport theorem; flow of incompressible frictionless fluid; laminar and turbulent flow of real fluids in closed conduits; impulse and momentum applied to fluids; fluid measurement. 3 lectures/problem-solving. Prerequisites: C– or better in ENG 104, MAT 214 and ME 215.

ME 312 Fluid Mechanics (3)

Similarity and dimensional analysis; steady closed conduit flow in pipes and pipe networks; flow of real compressible fluids; additional topics selected from boundary layers, and drag. 3 lectures/problem-solving, Prerequisites: C– or better in ME 301 and 311.

ME 313L Fluid Mechanics Laboratory (1)

Measurement of viscosity of fluids, centrifugal pump and/or fan performance, pressure drop in pipes, fluid rate meters, jet momentum and air velocity distribution in ducts. Calibration and use of laboratory equipment; design of a basic fluid mechanics experiment; acquisition, processing, and analysis of data by manual and automated methods; report writing. 1 three-hour laboratory. Prerequisites: A score of 6 or better on the GWT, C– or better in ME 231 and ME 311 or equivalent. Corequisite: ME 312.

ME 315 Engineering Materials (4)

A study of the relationship among structure, processing and properties of engineering materials. Strengthening mechanisms for ferrous and non-ferrous metals and the application of such materials in engineering situations. Phase diagrams and their relevance to the structure, processing and properties of metallic alloys. Mechanical behavior of polymers, ceramics and composites and their applications in engineering practice. Corrosion and degradation of materials. 4 lectures/problem solving. Prerequisites: CHM 122 and C– or better in ME 218.

ME 316 Intermediate Dynamics (3)

Three-dimensional particle and rigid body dynamics, motion relative to rotating reference frames, moments and products of inertia, momentum and energy principles, gyroscopic motion. 3 lectures/problem-solving. Prerequisites: C– or better in ME 215 and either MAT 216 or MAT 224.

ME 319 Stress Analysis (4)

Thick-walled pressure vessels, shrink fit, contact stresses, Castigliano's theorem, and other special topics. Failure theories, stress concentration, steady and repeated loading. fatigue and endurance strength, shaft design and analysis, fastener and spring analysis. 4 lectures/problem-solving. Prerequisites: C– or better in ENG 104, ME 219, ME 220L and ME 233/L.

ME 325/L Machine Design/Laboratory (3/1)

Design and application of machine components such as brakes, clutches, gears, mechanisms, bearings, ways, sleeves, and bushings. Lubrication of machine elements, gaskets, seals, "o" rings, and fasteners. Design techniques and the design of a simple machine. 3 lectures/problem-solving and 1 three-hour laboratory. Prerequisites: MFE 201/L, C– or better in ME 215, and ME 319.

ME 330 Engineering Numerical Computations (4)

Numerical methods applied to the solution of problems in engineering. Roots of equations, matrix methods, curve fitting, numerical integration and differentiation, numerical solution of differential equations. 4 lectures/problem-solving. Prerequisites: either MAT 216 or MAT 224, and C– or better in ME 232 or equivalent.

ME 340 Modeling and Simulation of Dynamic Systems (3)

Analysis and synthesis of steady-state and transient engineering problems associated with mechanical engineering. Emphasis is placed upon formulating the differential or fundamental equations from basic assumptions and applying various methods of solution. Computer simulations. 3 lecture/problem-solving. Prerequisites: ECE 231/231L, either MAT 216 or MAT 224, C– or better in ME 301 and 311.

ME 350L Materials Science and Selection Laboratory (1)

Laboratory tests of cold working, annealing, heat treatment, galvanic corrosion, and mechanical properties of materials. Material selection for prescribed applications. 1 three-hour laboratory. Prerequisites: C–or better in ME 315 and ME 231, or equivalent.

ME 400 Special Study for Upper Division Students (1–2)

Individual or group investigation, research, studies or surveys of selected problems. The student(s) must submit a proposal of the work to be done to the ME Curriculum Committee and obtain the committee's approval before beginning the proposed effort. Total credit limited to 4 units, with a maximum of 2 units per quarter.

ME 405 Acoustics and Noise Control (4)

Fundamental acoustic parameters (dB, dBA, PSIL, octave band). Physiological response to noise. Noise standards. Sound pressure-power relation. Noise measurement, with individual experience using a Precision Integrating Noise Meter. Noise suppression by absorption, isolation and resonators. Case studies in noise control and reduction. 4 lectures/problem-solving. Prerequisites: C– or better in ME 301, ME 311, MAT 215 and either MAT 216 or MAT 224.

ME 406/A Finite Element Analysis (3/1)

Stiffness and influence coefficients. Shape functions. Element stiffness. Coordinate transformations. Assemble stiffness matrix. Solution to give deflections and forces, or analogous parameters for heat transfer and fluid flows. Apply a widely-used finite element computer program (NASTRAN) to structure design, heat transfer and/or fluid flow. 3 lectures/problem-solving and 1 two-hour activity. Prerequisites: C– or better in ME 330 or ME 340 and ME 219.

ME 407/L Solar Thermal Engineering (3/1)

Solar radiation distribution and measurement; methods of solar energy collection; thermal analysis of flat plate solar collectors; experimental testing and efficiency determination; solar energy storage; solar economics; transient and long-term system performance; computer modeling for solar space and water-heating applications. 3 lectures/problem-solving and 1 three-hour laboratory. Prerequisite: C– or better in ME 301.

ME 408 Nuclear Engineering (4)

Nuclear power plant design, operation and safety. Reactor vessel internal and core components. Nuclear physics. Neutron reactions, fission and moderation. Reactor physics and reactor kinetics. 4 lectures/problem-solving. Prerequisites: either MAT 216 or MAT 224, PHY 133, C– or better in ME 301.

ME 409 Kinetic Theory/Statistical Thermodynamics (4)

Review of classical thermodynamics; kinetic theory of an ideal gas; distribution of molecular velocities; transport phenomena; quantum mechanics; Bose-Einstein quantum statistics; Maxwell-Boltzmann statistics; partition functions; advanced kinetic theory. 4 lectures/problem-solving. Prerequisites: C– or better in ME 301 and ME 311, or equivalents.

ME 411/L Heat Power/Laboratory (3/1)

Application of the principles of thermodynamics to actual power plant cycles. Rankine cycle and its variations; boiler and steam turbine heat balance and efficiency; steam plant auxiliaries, plant heat balance and efficiency; gas turbine and combined cycles. 3 lectures/problem-solving and 1 three-hour laboratory. Prerequisites: C– or better in ME 302 and ME 311.

ME 412/L Internal Combustion Engines/Laboratory (3/1)

The development of analytical and experimental techniques to estimate the performance of internal combustion engines. Discussion includes ideal and actual cycles, combustion, carburetion, fuel injection, ignition, supercharging, cooling, and fuels as applied to spark ignition and compression ignition engines. 3 lectures/problem-solving and 1 three-hour laboratory. Prerequisites: C– or better in ME 302.

ME 413 Mechanical Vibrations (4)

Free and forced vibration with and without damping. Periodic and aperiodic excitation. Rotating unbalance, vibration isolation, vibration measuring instruments, vibration of multiple degree of freedom systems, flexibility and stiffness coefficients, transfer matrices, computational methods. 4 lectures/problem-solving. Prerequisites: C– or better in ME 340.

ME 415 Heat Transfer (4)

Basic principles of conduction, convection, and radiation heat transfer. One-dimensional and multi-dimensional conduction, steady and unsteady state. Theoretical and empirical relations for free and forced convection in external surface flows and internal flows. Heat exchangers. Basic laws of radiation heat transfer, radiation properties of surfaces and radiant energy exchange among simple surfaces. 4 lectures/problem-solving. Prerequisites: C– or better in either MAT 216 or MAT 224, ME 301 and ME 311.

ME 417/L Building Energy Calculations/Laboratory (3/1)

Psychometrics; thermal environmental requirements for human habitation; calculation of building heating and cooling loads; predicting building energy use. 3 lectures/problem-solving and 1 three-hour laboratory. Prerequisites: C– or better in ME 302 and ME 311.

ME 418/L Air Conditioning/Laboratory (3/1)

Review of psychometrics; room air distribution; building air distribution systems; principles of refrigeration; refrigeration equipment; heating equipment; air conditioning system types. 3 lectures/problem-solving and 1 three-hour laboratory. Prerequisites: C– or better in ME 302, ME 312 and ME 415.

ME 421 Dynamics of Machinery (4)

Position, velocity and acceleration analysis of mechanical mechanisms by analytical, graphical and computer techniques. Determination of static and dynamic forces on machine components and linkages. Balancing of rotating masses. Critical speeds of shafts. Analysis of gyroscopic action with applications. 4 lectures/problem-solving. Prerequisites: C– or better in ME 316.

ME 425/L Advanced Machine Design/Laboratory (3/1)

The emphasis of this course is placed on the actual process of modern design of complete mechanisms and machines based on solid modeling and finite element analysis. The projects are so chosen as to demand the application of knowledge learned in other courses and act as a synthesizing agent. Real industrial problems are used as projects. 3 lectures/problem-solving and 1 three-hour laboratory. Prerequisites: C– or better in ME 325/L.

ME 427 Thermal Systems Design (4)

Piping networks, sizing and design of a pipe system, fluid transients, rotary pump design and selection, heat exchanger design, thermal system simulation using computer-aided analytical techniques. Preliminary design and preparation of specifications for procurement of thermal fluid mechanical equipment to meet performance requirements. 4 lectures/problem-solving. Prerequisites: C– or better in ME 302, ME 312 and ME 415.

ME 435/L Theory and Design for Mechanical Measurement/Laboratory (3/1)

Analysis of the generalized measurement system with application of sensing, modifying and signal read-out equipment to problems of engineering measurements. Harmonic analysis; uncertainty and error analysis. 3 lectures/problem-solving and 1 three-hour laboratory. Prerequisites: C– or better in ME 340 and ME 313L.

ME 439/L Control of Mechanical Systems/Laboratory (3/1)

Design and comparison of hydraulic, pneumatic and electrical control systems. Pneumatic, hydraulic and electrical control circuit theory and design. The design and programming of control circuits using microprocessors. Introduction to Programmable Logic Controllers. Application of control systems in thermal, mechanical and mechatronic systems. 3 lectures/problem solving and 1 three-hour laboratory. Prerequisites: C- or better in ME 340.

ME 460 Team Senior Design Project (4)

Design, fabrication and testing of a project(s) selected by and under supervision of a faculty member. Students work in small groups. Project results are presented through periodic written and/or oral progress reports and a written formal final report. 4 lecture discussions. Prerequisites: C- or better in ME 315 and 325, and completion of all junior level courses.

ME 461, 462 Senior Project (2) (2)

Selection and completion of a project under faculty supervision. Projects typical of problems which graduates must solve in their fields of employment. Project results are presented in a formal report. Minimum 120 hours total time. Prerequisites: C– or better in ME 315 and ME 325, and completion of all junior level courses.

ME 463 Undergraduate Seminar (2)

New developments, policies, practices, procedures and ethics in mechanical engineering. Each student is responsible for the preparation of a technical report or senior project proposal and the development and oral presentation of a topic in the field of mechanical engineering. 2 lectures/seminars. Prerequisites: satisfaction of the GWT requirement and completion of all 300-level courses.

ME 471, 472, 473 Professional Practice (1), (1), (2)

Supervised employment in a professional engineering environment. Placement arranged by student and approved by faculty advisor. Requires: satisfactory completion of work assignment (20 hours per week for three quarters for credit for 471, 472 and 473); periodic progress reports; and a written final report. Prerequisite: senior standing.

ME 499/499A/499L Special Topics for Upper Division Students (1–4)

Group study of a selected topic, the title to be specified in advance. Total credit limited to 8 units, with a maximum of 4 units per quarter. Instruction is by lecture, laboratory, or a combination.