MECHANICAL ENGINEERING

College of Engineering and Computer Science

Program Description

Mechanical Engineering involves the design of all types of machines and equipment including vehicles used in ground, air, and space transportation; machines for the conversion of fuels into energy; food processing; consumer products; robots; biomedical devices; the machines used to manufacture all of the above; and the climate control of buildings. Mechanical engineers bring together the fields of design graphics, manufacturing, engineering materials, thermodynamics and heat transfer, and the principles of mathematics and science to find solutions to societal needs. They often work directly in the design and operation of food processing plants, power plants, manufacturing plants, refineries, and other industrial operations. A major goal of the curriculum is to provide the graduates with the analytical and practical skills needed to perform mechanical design in a variety of fields, preparing graduates to take advantage of the many employment opportunities.

The Mechanical Engineering Program includes courses on design, thermal sciences, manufacturing, properties, and selection of materials, and computer applications related to these topics. The curriculum maintains a balance among basic fundamentals, analytical methods, and design applications of current knowledge, preparing the graduates for both entry into the profession and a life-long career.

The employers of Mechanical Engineering graduates include aircraft and automobile companies, food processing companies, machinery and equipment companies, gas and electric utilities, architectural and engineering firms, and many agencies in federal, state, and local governments. Some graduates continue their education by completing advanced degrees in Engineering or Management.

Degree Programs

BS in Mechanical Engineering (http://catalog.csus.edu/colleges/engineering-computer-science/engineering-mechanical/bs-in-mechanical-engineering/)

Blended BS/MS in Mechanical Engineering Program (http://catalog.csus.edu/colleges/engineering-computer-science/engineering-mechanical/blended-bs-ms-in-mechanical-engineering-program/)

MS in Mechanical Engineering (http://catalog.csus.edu/colleges/engineering-computer-science/engineering-mechanical/ms-in-mechanical-engineering/)

- Specializations in Aerospace Systems, Design & Dynamic Systems, Manufacturing & Materials Engineering, and Thermal & Fluid Systems

Accreditation

In addition to California State University, Sacramento's full accreditation by the Western Association of Schools and Colleges, the Bachelor of Science in Mechanical Engineering is also individually accredited by ABET, Inc.

Notice to Students RE: Professional Licensure and Certification

California State University programs for professions that require licensure or certification are intended to prepare the student for California licensure and certification requirements. Admission into programs for professions that require licensure and certification does not guarantee that students will obtain a license or certificate. Licensure and certification requirements are set by agencies that are not controlled by or affiliated with the California State University and licensure and certification requirements can change at any time.

The California State University has not determined whether its programs meet other states' educational or professional requirements for licensure and certification. Students planning to pursue licensure or certification in other states are responsible for determining whether, if they complete a California State University program, they will meet their state's requirements for licensure or certification. This disclosure is made pursuant to 34 CFR §668.43(a)(5)(v)(C).

Special Features

- The Mechanical Engineering program is ABET accredited by the Engineering Accreditation Commission (EAC/ABET),
  Engineering Accreditation Commission (EAC/ABET)
  111 Market Place, Suite 1050
  Baltimore, Maryland 21202
  (410) 347-7700
  In keeping with its accreditation, the Mechanical Engineering program has strong engineering design content. In particular, the program includes a four-semester sequence on modern design and manufacturing methods.
- Faculty members have backgrounds in Mechanical, Aeronautical, Manufacturing, and Materials Science. The faculty has a variety of research interests; the majority has industrial experience which contributes to the applied emphasis in the Mechanical Engineering program. Most of the faculty have doctorates; some are registered Professional Engineers (PE).
- Lectures and lab are arranged so students can participate in meaningful discussions and a real exchange of ideas between students and faculty.
- Upper division students do cooperative work on team projects and often develop study groups for other courses.
- Courses taken in the freshman and sophomore years form a foundation for the upper division program; e.g., the dynamics and strength of materials studied in the junior year depend on the sophomore mechanics, calculus, and physics courses. Building on analytical and communications skills learned in the lower division, students take a four semester design-project sequence which includes the study of design methods, and the procedures for developing a design solution from concept through a fully-developed design and finally to production. The courses in mechanics, energy transformation, manufacturing, and materials support this sequence.
- Students can take elective courses in computer analysis, heating, ventilating and air-conditioning, manufacturing methods, and systems and materials engineering.

Program Educational Objectives

Mechanical Engineering Graduates will have:

- utilized a foundation in engineering and science to engage in successful careers in mechanical engineering or other fields to the benefit of society.
- become effective participants or leaders in innovation and multi-disciplinary collaboration to address global technical, social, and industrial issues.

- engaged in career and professional development through self-study, continuing education, or graduate studies in engineering or other professional fields.

Academic Policies and Procedures

Course Repeat Policy - Undergraduate engineering and mechanical engineering courses that are used to meet the Bachelor of Science in Mechanical Engineering degree requirements may be repeated only twice (for a total of three attempts). Grades of the second and third attempts will be averaged in grade point calculations.

Incomplete Grades - Incomplete grades are issued only in accordance with University policy. The student must be passing the course at the time an "Incomplete" is requested. An Incomplete Petition must be submitted to the Department with the student's and the course instructor's signature. The Incomplete Petition (obtained in the Department Office) must specify the work to be completed, the basis by which the student's final grade will be determined, and the last date for completion of the incomplete work. An incomplete grade that is not cleared by the set date will lapse to an "F" grade.

Career Possibilities

Aeronautical Engineer · Automotive Engineer · Design Engineer · Development Engineer · Energy Management Engineering Manager · Environmental Engineer · Food Processing Machine Designer · Manufacturing Engineer · Plant Engineer · Project Engineer · Research Engineer · Technical Sales Engineer

Contact Information

Troy D. Topping, Ph.D., Department Chair
Riverside Hall, Room 4024
(916) 278-6624

Department of Mechanical Engineering Website (http://www.ecs.csus.edu/wcm/me/)

Faculty

EKE, ESTELLE

GRANDA, JOSE

HOMEN, PATRICK

KUMAGAI, AKIHIKO

MARBACH, TIMOTHY L.

MEIER, ALAN

ROMANI, MARCUS

SOBHAN, SARVENAZ

SPROTT, KENNETH S.

SUH, YONG S.

TANG, HONG-YUE (RAY)

TOPPING, TROY

TUZCU, ILHAN

VOGT, RUSTIN

ZABIHIAN, FARSHID

ME 37. Manufacturing Processes. 3 Units
Term Typically Offered: Fall, Spring, Summer

Principles of manufacturing processes in the areas of metal removal, forming, joining and casting and fundamentals of numerical control. Study includes applications of equipment, e.g., lathe, milling machine, drill press, saw, grinder, welder, molding equipment and core makers. Emphasis on safety during hands-on operations. Two hours lecture, one three-hour lab.

ME 76. Programming and Problem Solving in Engineering. 2 Units
Prerequisite(s): Math 30; Phys 11A; Phys 11A may be taken concurrently
Term Typically Offered: Fall, Spring, Summer

Introduction to the use of computers for engineering, science and mathematical computations. Provides basic computer operation skills, and includes the use of modern interactive symbolic and numerical computation packages as well as an introduction to programming methods for solving engineering problems. Both analytical and graphical tools will be used for applications. Sample applications will be drawn from a variety of science and engineering areas.

ME 105. Introduction to Technical Problem Solving. 3 Units
Prerequisite(s): ENGR 17 and ENGR 30.
Term Typically Offered: Fall, Spring, Summer

Introduction to the use of computers for engineering, science and mathematical computations. Introduction to linear algebra and matrix applications. Introduction to concepts of programming and visualization using MATLAB and PBasic. Practical applications involving design using a microcontroller. Applications will be drawn from a variety of science and engineering areas. Lecture two hours, Laboratory three hours.

ME 106. Applications of Programming in Mechanical Engineering. 1 Unit
Prerequisite(s): ME 76 or equivalent
Term Typically Offered: Fall, Spring, Summer

Application of programming in the solution of practical engineering problems. Topics include problem formulation, algorithm development, advanced graphical user-interface development, and generating simulations using software packages such as Simulink. A project that involves programming a robot to perform designated tasks is included. Laboratory 1 unit.

ME 108. Professional Topics for Mechanical Engineers. 2 Units
Prerequisite(s): MATH 31. MATH 31 may be taken concurrently.
Term Typically Offered: Fall, Spring

Introduction to statistical methods applied to analysis of engineering systems. Topics include data collection, distribution characteristics, probability, uses of regression analysis, and decision-making under uncertainty. Introduction to economic analysis applied to engineering designs. Topics include marginal or incremental economic analysis using multiple standard methods while addressing organizational constraints and market factors. Investigations into the roles engineers play in society in working toward sustainability, and ethical decision making in a technological world.

ME 114. Vibrations. 3 Units
Prerequisite(s): ENGR 110, ME 105.
Term Typically Offered: Fall, Spring

Generation of equations of motion for single and multiple degree freedom systems. Study of natural frequencies, eigenvectors, free and forced response, modes of vibration and vibration control and isolation. Mechanical and structural vibrations with applications to rotating machinery and vehicles. Fundamentals of acoustics and the engineering of musical instruments.

ME 115. Dynamics of Machinery and Multi-Body Systems. 3 Units
Prerequisite(s): ENGR 110, ME 105.
Term Typically Offered: Fall, Spring

Kinematic and kinetic analysis of mechanisms. Rigid and flexible multi-body assembly models in two and three dimensions. Use of solid modeling, dynamic analysis and finite element methods. Study of loads on linkages, cams, gears as integral functioning components of machines, ground and space vehicles. Study of forces and moments in machinery under impulsive and impact forces, balancing, and elements of vibration.

ME 116. Machinery Design I. 2 Units
Prerequisite(s): ENGR 112, and ME 37. ENGR 112 and ME 37 may be taken concurrently.
Term Typically Offered: Fall, Spring, Summer

Introduction to basic design methodology for mechanical systems and devices. Detail design of machine components; application of analytical methods in the design of complex machines. Failure mode analysis, theories of failure, yield, fracture, deflection, and fatigue analysis of machine elements. Design of common machine elements such as bearings and shafts.

ME 117. Machinery Design II. 2 Units
Prerequisite(s): ME 116.
Term Typically Offered: Fall, Spring

Introduction to design of machine components; application of analytical methods in the design of complex machines. Design of common machine elements such as threaded fasteners, springs, flexible drive components, gears, and friction devices. Introduction to stress and deflection analysis using finite element software.

ME 120. Fluid Mechanics for Mechanical Engineers. 3 Units
Prerequisite(s): ENGR110 or concurrent enrollment.
Term Typically Offered: Fall, Spring, Summer

Fundamentals of fluid mechanics, including fluid statics; mass, momentum and energy conservation laws and analysis; inviscid and viscous (laminar, turbulent) flow; pumps, turbines, internal flow in pipes; external flow on moving or submerged objects; dimensional analysis, modeling, applications. Lecture. 3 units.

ME 121. Solar Thermal and Energy Storage Systems. 2 Units
Prerequisite(s): ENGR 124.
Term Typically Offered: Fall, Spring

Study of solar thermal heat and power and energy storage including the characterization, theory, operation, analysis and modeling of solar thermal and energy storage systems.

ME 122. Geothermal and Bioenergy Systems. 2 Units
Prerequisite(s): ENGR 124
Term Typically Offered: Fall, Spring

Study of geothermal and bioenergy systems including the characterization, theory, operation, analysis and modeling.

ME 123. Wind, Hydro and Ocean Energy. 3 Units
Prerequisite(s): ENGR 124 and ME120.
Term Typically Offered: Fall, Spring

Exploring sustainable energy and power generation, through study of wind, hydro and ocean energy systems, including the characterization, theory, operation, analysis, modeling, planning impacts and design process.

ME 126. Heat Transfer. 3 Units
Prerequisite(s): ENGR 124 and ME 120.
Term Typically Offered: Fall, Spring, Summer

Basic principles of heat transfer, including processes of conduction, convection, radiation, evaporation and condensation. Lecture three hours.

ME 126W. Heat Transfer Workshop. 1 Unit
Corequisite(s): ME 126.
Term Typically Offered: Fall, Spring, Summer

Problem solving and discussion of heat transfer to enhance students' understanding of subject matter.
Note: May be repeated for credit.

Credit/No Credit

ME 128. Thermal-Fluid Systems. 3 Units
Prerequisite(s): ME 126 (may be taken concurrently).
Term Typically Offered: Fall, Spring, Summer

Fundamentals of the Otto, Diesel, Brayton and Rankine power cycles, vapor-compression refrigeration, psychrometric processes and chemical reactions. Theory and application of temperature, pressure, flow, and velocity instruments, introduction to experiment design, errors, uncertainty and data acquisition, data analysis and presentation.

ME 129. Power Plant Engineering. 3 Units
Prerequisite(s): Thermodynamics (ENGR 124) and Thermal-Fluid Systems (ME 128). ME 128 may be taken concurrently
Term Typically Offered: Fall, Spring

In this course, the students will be able to understand the fundamentals of power industry, including electricity production, transmission, and distribution. They will also apply their engineering knowledge gained in the fundamental courses to understand and conceptually design various modern power plant technologies for electric power generation and cogeneration, including steam power plants, gas turbines, combined cycles, and nuclear power plants and their components.

ME 132. Solar Energy, Geothermal Energy, and Bioenergy Systems. 3 Units
Prerequisite(s): Thermodynamics (ENGR 124)
Term Typically Offered: Fall, Spring

In this course, the students will study solar energy, geothermal energy, and bioenergy systems. They will apply their engineering knowledge gained in the fundamental courses to design these systems. They will also learn about theoretical foundations, characterization, operation, and environmental impacts of these energy systems.

ME 136. Numerical Control Programming. 3 Units
Prerequisite(s): ME 37 and ME 105; ME 105 may be taken concurrently.
Term Typically Offered: Fall, Spring

Computer programming languages for automated manufacturing, including CNC manual programming, cutter compensation, geometric definition of products, cutting tool definition, continuous path part programming, computation, decision, looping, computer graphics programming and intelligent machines.

ME 137. Product Design for Manufacturing and Automation. 3 Units
Prerequisite(s): ME 117.
Term Typically Offered: Fall, Spring

Various manufacturing and automation aspects of product design, including design for machining, design for automation, applications of CAD/CAM software in product design and automation, and rapid prototyping. Virtual design and manufacturing and agile manufacturing will also be discussed.

ME 138. Concurrent Product and Process Design. 3 Units
Prerequisite(s): ME 37 and ME 116.
Term Typically Offered: Fall, Spring

Manufacturing considerations in product design including: design for manufacturing (DFM), design for assembly (DF A), design to cost (DTC), design to life cycle cost (DTLCC), design for quality and reliability (DFQR); introduction to concurrent engineering. Two hours lecture, three-hour lab.

ME 140. Introduction to Motors and Actuators. 2 Units
Prerequisite(s): ME 172 or EEE 184.
Term Typically Offered: Fall, Spring

Power conversion hardware used in electromechanical systems. Operation and sizing of electric motors, both DC and AC systems, motor controllers, and power electronics; sensors; design in fluid power systems, both pneumatic and hydraulic; and power transmission systems such as ball screws and belt drivers.

ME 141. Introduction to Tolerance Analysis. 2 Units
Prerequisite(s): ME 116
Term Typically Offered: Fall, Spring

Introduction to techniques used in manufacturing tolerance analysis. Assembly tolerance analysis using standard industry practices; application of geometric dimensioning techniques to tolerance analysis; drawing practices for indicating dimensional tolerances; statistical techniques; tolerance allocation. Introduction to computer aided tolerance analysis.

ME 143. Vehicle Dynamics and Design. 3 Units
Prerequisite(s): ENGR 110 and ME 117.
Term Typically Offered: Fall, Spring

Principles and practice in vehicle dynamics and design using computer aided techniques. Design methods for passenger vehicles, SUVs, trucks, motorcycles and space vehicles. Study of tires, drivetrain and gear boxes in ground vehicles. Kinematics and kinetics of mechanisms in two and three dimensions with applications to suspensions, steering mechanisms. Frame design using finite element analysis, power trains, braking, auxiliary systems. Computer dynamic models for analysis of vehicle stability, collisions rollovers, and failure analysis using state-of-the-art software.

ME 145. Vehicle Crash Reconstruction. 3 Units
Prerequisite(s): ENGR 110
Term Typically Offered: Fall, Spring

Study of forensic engineering using state of the art technology. Application of principles of dynamics for forensic investigation and reconstruction of vehicle collisions. Cases involving, cars, motorcycles, bicycles and commercial vehicles. Study of devices that contribute to passenger safety and stability. Analysis of seat belts, airbags, and electrohydraulic stabilizers. Data analysis of Event Data Recorders (EDRs) and verification with real cases using state of the art reconstruction techniques, photogrammetry and the use of computer simulations in two and three dimensions.

ME 151. Fundamentals of Combustion. 3 Units
Term Typically Offered: Fall, Spring

Principles of combustion and pyrolysis of gaseous, liquid, and solid materials. Applications of principles, including analysis and design of stationary and mobile powerplants, waste management, and fire safety.

ME 152. Turbomachinery Design. 3 Units
Prerequisite(s): ME 120 and ENGR 124
Term Typically Offered: Fall, Spring

Theoretical analysis of energy transfer between fluid and rotor; principles of axial, mixed, and radial flow compressors and turbines. Applications and computer-aided design of various types of turbomachines.

ME 153. Thermodynamics of Combustion Engines. 3 Units
Prerequisite(s): ENGR 124, ENGR 132, ME 105.
Term Typically Offered: Fall, Spring

Application of thermodynamic and fluid mechanical analysis to various kinds of engines, including those based on Otto, Diesel, Brayton, Rankine, and Stirling cycles. Development of computer models and comparison of cycles in terms of applications to land, marine, and aerospace propulsion.

ME 154. Alternative Energy Systems. 3 Units
Prerequisite(s): ENGR 124.
Term Typically Offered: Fall, Spring

Study of alternative energy technologies, such as renewable fuels, wind, solar, oceanic and geothermal power. Concentration on fundamental thermodynamic principles, modern design features and non-technical aspects of each technology.

ME 155. Gas Dynamics. 3 Units
Prerequisite(s): ME 105.
Term Typically Offered: Fall, Spring

Thermodynamics and mechanics of one-dimensional compressible flow; isentropic flow; normal and oblique shock waves; Prandtl-Meyer flow. Combined effects in one-dimensional compressible flow. Nozzles, diffusers and shock tubes. Computer use in gas dynamics.

ME 156. Heating and Air Conditioning Systems. 3 Units
Prerequisite(s): ENGR 124, ENGR 132.
Term Typically Offered: Fall, Spring

Theory and design of heating, ventilating and air conditioning for industrial and comfort applications. Topics include refrigeration cycles, heating and cooling load calculations, psychrometrics, solar heating and cooling component, and system design.

ME 157. Solar Energy Engineering. 3 Units
Prerequisite(s): ME 126; may be taken concurrently.
Term Typically Offered: Fall, Spring

In-depth study of the basics of solar engineering, including the nature and availability of solar radiation; operation, theory and performance of solar collectors; energy storage and model of solar systems.

ME 159. High Efficiency HVAC. 3 Units
Prerequisite(s): ME 156 or instructor permission.
Term Typically Offered: Fall, Spring

Starts with a review of the theory and design of HVAC systems. Recent improvements and new developments in cooling and heating equipment are studied in detail. Computer models such as the Trane TRACE Program are used to size an HVAC system with an emphasis on high efficiency. Computer based controls and energy management systems are discussed and demonstrated. Field trips to energy efficient installations are included.
Field trip(s) may be required.

ME 164. Introduction to Test Automation. 3 Units
Prerequisite(s): ME 105, ME 117.
Term Typically Offered: Fall, Spring

Basic concepts to automate testing procedures. Introduction to sensors, signal conditioning, sampling theory, design of experiments, data acquisition software, and data reduction techniques. Hands-on experience with PC based data acquisition software and hardware which will be used to create testing programs. Lecture two hours; laboratory three hours.

ME 165. Introduction To Robotics. 3 Units
Prerequisite(s): ME 105, ME 116
Term Typically Offered: Fall, Spring

Fundamentals of design and application of industrial robotics. Manipulator kinematics, trajectory planning and controller design, design of end effectors and actuators, sensors, programming languages, and machine vision. Applications in manufacturing, approach to implementing robotics, economic analysis for robotics. Lecture two hours; laboratory three hours.

ME 171. Modeling and Simulation of Mechatronics and Control Systems. 3 Units
Prerequisite(s): ENGR 110, ME 105.
Term Typically Offered: Fall, Spring, Summer

Computer modeling and mathematical representation of mechanical, electrical, hydraulic, thermal, and electronic systems or combinations of these. Development of system design criteria and solutions using computer simulation. Use of state of the art automated modeling and simulation methods to build models of multi-energy mechatronics and control systems. Vibration concepts, applied, natural frequencies, eigenvectors, and solution of differential equations using computer simulation. Introduction to state variable feedback control systems. A design project is required.

ME 172. Control System Design. 3 Units
Prerequisite(s): ME 171.
Term Typically Offered: Fall, Spring, Summer

Use of mathematical models for the generation of equations of motion for mechanical and electrical systems. Evaluation of single and multiple degrees of freedom systems in the time and frequency domain. Topics include feedback control systems, Laplace transform, state space representation, transfer functions, error analysis, stability of control systems and system response. Automatic control system design using root locus and frequency response methods. Design of compensating controls using state of the art software and automation tools. Introduction to digital control.

ME 173. Applications of Finite Element Analysis. 3 Units
Prerequisite(s): ENGR 112, ME 105.
Term Typically Offered: Fall, Spring

Mathematical fundamentals of Finite Element Modeling (FEA). Engineering analysis and design of structural members, and machinery components using FEA models. Model generation using computer graphics. Computer solutions of static, dynamic, heat transfer, stress analysis, fluid mechanics and structural problems.

ME 176. Product Design & CAD. 3 Units
Prerequisite(s): ENGR 6, ME 105 and ME 116.
Term Typically Offered: Fall, Spring

Digital product development using an integrated CAD system. Philosophy of parametric design. Component and assembly design, basic drawing creation, and simulations. Team product design investigating the effects of variations in geometry, dimensions, and material selection. Lecture two hours; laboratory three hours.

ME 177. Product Design and 3D Parametric Solid Modeling. 3 Units
Prerequisite(s): ENGR 6, ME 105 and ME 116.
Term Typically Offered: Fall, Spring

Introduction to Solid Modeling and its application to mechanical product design. Digital product development using 3D Parametric Solid Modeling tools. Also covers component and assembly design, basic drawing creation. Reverse design project engineering investigating the effects of variations in geometry, dimensions, and material selection. Lecture two hours; laboratory three hours.

ME 180. Mechanical Properties of Materials. 3 Units
Prerequisite(s): ENGR 112
Term Typically Offered: Fall, Spring, Summer

Principles of mechanical properties of metals, including strength under combined loads, fatigue, and fracture mechanics. Laboratory includes study of strengthening mechanisms, and principles of experimental stress analysis. Lecture two hours; Laboratory three hours.

ME 180W. Mechanical Properties of Materials Workshop. 1 Unit
Corequisite(s): ME 180.
Term Typically Offered: Fall, Spring, Summer

Problem solving and discussion of mechanical properties of materials to enhance students' understanding of subject matter.
Credit/No Credit

ME 182. Introduction to Composite Materials. 3 Units
Prerequisite(s): ME 180.
Term Typically Offered: Fall, Spring

Properties, mechanics, and applications of anisotropic fiber-reinforced materials with an emphasis on the considerations and methods used in the design of composite structures.

ME 183. Materials Selection in Engineering Design. 3 Units
Prerequisite(s): ENGR 45 and ME 116. ME 116 may be taken concurrently.
Term Typically Offered: Fall, Spring

Quantitative treatment of materials selection for engineering applications. Discussion of the relationship between design parameters and materials properties. Emphasis on the influence of processing and fabrication on the properties of metals, ceramics, polymers and composites as related to the overall design process. Sustainability, Eco-Design, and manufacturability considerations.

ME 184. Corrosion and Wear. 3 Units
Prerequisite(s): ME 180.
Term Typically Offered: Fall, Spring

Introduction to the phenomena of corrosion and wear, including the electro-mechanical bases of corrosion, examples of corrosion of iron, steel and stainless steels, and prevention of corrosion. Fundamentals of wear are covered including effects of loads, material properties, and lubrication on wear rates.

ME 186. Fracture Mechanics in Engineering Design. 3 Units
Prerequisite(s): ME 180.
Term Typically Offered: Fall, Spring

Fracture mechanics approach to mechanical design; role of microstructure in fracture toughness and embrittlement; environmentally-induced cracking under monotonic and fatigue loads; laboratory techniques; service failures in various industries and failure mechanisms.

ME 190. Project Engineering I. 3 Units
Prerequisite(s): ME 117
General Education Area/Graduation Requirement: Upper Division Further Studies in Area B5, Further Studies in Area B (B5)
Term Typically Offered: Fall, Spring, Summer

Beginning of a two semester project; design of a product, device, or apparatus that will be fabricated in ME 191. Students work in small groups, interacting with product users, vendors, technicians, and faculty advisors. Lecture two hours; laboratory three hours.

ME 191. Project Engineering II. 2 Units
Prerequisite(s): ME 190.
Term Typically Offered: Fall, Spring, Summer

Continuation of the project begun in ME 190. Part II consists of fabrication and assembly of equipment, testing and evaluation, and reporting. Seminar one hour; laboratory three hours.

ME 194. Career Development in Mechanical Engineering. 1 Unit
Prerequisite(s): Senior status.
Term Typically Offered: Fall, Spring

Designed for Mechanical Engineering students making career decisions. Instruction will include effective career planning strategies and techniques including skill assessment, employment search strategy, goal setting, time management, interview techniques and resume writing. Lecture one hour.
Note: Units earned can not be used to satisfy major requirements.

Credit/No Credit

ME 195. Professional Practice. 1 - 6 Units
Prerequisite(s): Instructor permission.
Term Typically Offered: Fall, Spring

Supervised employment in a professional engineering or computer science environment. Placement arranged through the College of Engineering and Computer Science. Requires satisfactory completion of the work assignment and a written report.
Credit/No Credit

ME 195A. Professional Practice. 1 - 12 Units
Prerequisite(s): Instructor permission.
Term Typically Offered: Fall, Spring

Supervised employment in a professional engineering or computer science environment. Placement arranged through the College of Engineering and Computer Science. Requires satisfactory completion of the work assignment and a written report.
Credit/No Credit

ME 196A. Motion and Dynamic Analysis using Solid Modeling. 3 Units
Prerequisite(s): ENGR 6 and ME 117.
Term Typically Offered: Fall, Spring

Practical approach to study of motion and dynamic analysis of machine components and assemblies in two or three dimensions. Uses solid modeling software to analyze the forces, moments and dynamic loads for parts and entire assemblies in motion. Topics include stress and strain during motion, kinematics, kinetics, drop tests in two and three dimensions, frequency analysis, buckling, dynamic fatigue and finite element analysis, time history of motion, harmonics, and vibrations.

ME 196B. Engineering Systems Approach to Product Design. 2 Units
Prerequisite(s): ME 116
Term Typically Offered: Fall, Spring

Study of product design process and formal design methodologies. Various topics in product and system design including creativity, visualizations and communications, human factors, design for X methodology decision science, economics, product design and robust quality design.

ME 196C. Computer Programming for Mechanical Engineering Applications. 2 Units
Prerequisite(s): ME 105
Term Typically Offered: Fall, Spring

Computer programming languages such as C/C++, Java, Processing, and their applications to engineering problem solving using computer graphics, simulations, and physical prototyping. Programming computer communications with microprocessors for controlling sensors and motors.

ME 196D. Ground Vehicle Aerodynamics. 3 Units
Prerequisite(s): ENGR 132
Term Typically Offered: Fall, Spring

Fundamental and applied subjects of aerodynamics for ground vehicle design and performance including flow features, aerodynamic forces, drag reduction strategies, and different methodologies for evaluation of aerodynamic forces and vehicle design. Numerical modeling approaches with experience of running a commercial computational fluid dynamics program. Units: 3 Units (2 Unit Lecture and 1 Unit Lab)

ME 196E. Vehicle Safety and Crash Reconstruction. 3 Units
Term Typically Offered: Fall, Spring

Study of forensic engineering using state of the art technology in vehicles that contribute to passenger safety and stability. Application of principles of dynamics for forensic investigation and reconstruction of vehicle collisions. Study of seat belts, airbags, and electrohydraulic stabilizers. Study of the Event Data Recorders (EDRs), data analysis and verification with real cases using classical reconstruction techniques, and the use of computer simulations in two and three dimensions.

ME 196F. Materials Selection in Engineering Design. 3 Units
Prerequisite(s): ENGR 45 and ME 116. ME 116 may be taken concurrently.
Term Typically Offered: Fall, Spring

Quantitative treatment of materials selection for engineering applications. Discussion of the relationship between design parameters and materials properties. Emphasis on the influence of processing and fabrication on the properties of metals, ceramics, polymers and composites as related to the overall design process. Sustainability, Eco-Design, and manufacturability considerations.

ME 196H. Air Resources Engineering. 2 Units
Prerequisite(s): ENGR 124 and ENGR 132. ENGR 132 may be taken concurrently.
Air quality standards. Stationary and transportation emission sources. Chemical and physical interactions of air pollutants, including greenhouse gases, with the atmosphere. Introduction to air quality modeling, including atmospheric temperature effects due to longwave thermal radiation. Air Quality measurement. Emission control strategies and design. Air resources economics and policy.

ME 196M. Engineering Research Methodology and Communication for Undergraduate Students. 3 Units
Prerequisite(s): ME 108
Term Typically Offered: Fall, Spring, Summer

This course will prepare students for engineering research by introducing them to how to identify, plan, conduct, and present a research project as well as research methods, literature review process, research ethics, writing proposal, writing technical reports, and oral and poster research presentations. The students will be conducting an independent supervised engineering research on an agreed-upon research project. They will refine their communication skills by working one-on-one with the instructor to present their research in a professional setting.

ME 196Q. Ceramic Materials. 3 Units
Prerequisite(s): ENGR 112
Term Typically Offered: Fall, Spring

Fundamentals of structure, processing and properties of engineering ceramics with an emphasis on the relationships between them. Industrial applications for ceramic and glass components along with the processing and materials selection options available for a given material and application. Topics covered include common ceramic structures, thermal and physical properties of ceramics, powder processing, creep resistance and toughening mechanisms, electronic properties of ceramics, and glass forming.

ME 196R. Fundamentals of Physical Metallurgy and Materials. 3 Units
Prerequisite(s): ENGR 112 or equivalent course.
Term Typically Offered: Fall, Spring

Fundamentals of structure, processing and properties of metals and metal alloys with emphasis on relationships between them. Thermodynamics and kinetics of common phase transformations and resulting microstructures and mechanical properties. Slip mechanisms in single crystals, and metallic alloy strengthening mechanisms including grain size, solute, precipitation, cold-work, and martensite. Specific heat treatment and mechanical processing procedures for steel and aluminum alloys as well as application of these processes to other alloy systems.

ME 199. Special Problems. 1 - 3 Units
Term Typically Offered: Fall, Spring

Individual projects or directed reading.
Note: Open only to students who appear competent to carry on individual work. Admission requires approval of an instructor and the student's advisor. May be repeated for credit.

Credit/No Credit

ME 206. Stochastic Modeling for Engineers. 3 Units
Prerequisite(s): MATH 45 or equivalent.
Term Typically Offered: Fall, Spring

Fundamentals and applications of stochastic processes for engineers, including a review of engineering statistics, autoregression moving average (ARMA) models, characteristics of ARMA models, ARMA modeling and forecasting, and transformation from discrete models to continuous models. Applications of stochastic processes in engineering field, e.g., precision manufacturing, monitoring and diagnosis of machines, tools, and processes, system identification, vibrations, and statistical process control (SPC).

ME 209. Research Methodology. ✎ 2 Units
Prerequisite(s): Graduate status in Mechanical Engineering.
Term Typically Offered: Fall, Spring

Research methodology and engineering approach to problem solving. Includes an orientation to the requirements for Master's thesis in Mechanical Engineering. Students will be exposed to a variety of possible thesis topics. Students will be required to complete an essay concerning aspects of engineering research. The student will be required to prepare a presentation and also review other students work.
Note: Graduate Writing Intensive (GWI) course.

ME 233. Intelligent Product Design and Manufacturing. 3 Units
Prerequisite(s): ME 105, ME 138.
Term Typically Offered: Fall, Spring

Application of expert systems, fuzzy logic and neural networks in product design and manufacturing. Concurrent product and process design using expert systems and fuzzy logic. Monitoring tool conditions and manufacturing processes using neural networks so as to achieve high quality, high efficiency, and automation.

ME 236. Computer Controlled Manufacturing Processes. 3 Units
Prerequisite(s): ME 105, ME 138.
Term Typically Offered: Fall, Spring

Applications of logic and motion controls in manufacturing. Computer controlled open and feedback systems. CNC machining processes, CNC programming. Applications of robots in manufacturing, programming for robots. PLC logic controls, sensors and output devices, creating ladder logic diagrams for the PLCs. Design for Manufacturing (DFM) and Design for Assembly (DFA) of modern computer controlled machines.
Note: Lectures as well as some tutorial activities are covered in two 75-minute classes per week.

ME 237. Digital Control of Manufacturing Processes. 3 Units
Prerequisite(s): ME 105, ME 138, MATH 45.
Term Typically Offered: Fall, Spring

Introduction to both the theory and applications of digital control of manufacturing processes, including the discrete controller for manufacturing, digital controlled systems for manufacturing, sensors of control loop for manufacturing, discrete process models for manufacturing, manufacturing system input and response, and stability analysis of manufacturing systems.

ME 238. Automated Inspection. 3 Units
Prerequisite(s): ME 105, ME 138.
Term Typically Offered: Fall, Spring

Introduction to measurement for machine accuracy and process quality including the use of coordinate measuring machines; system considerations and sensor technology in automated visual inspection; applications of pattern recognition in automated inspection.

ME 240. Mechanical Design & Failure Analysis. 3 Units
Term Typically Offered: Fall, Spring

Advanced multidisciplinary design analysis, finite element modeling, computer simulations, and statistical methods to increase product safety and reduce product liability. Investigate and recreate cases of failures of machines, vehicles, structures and assemblies under dynamic or static loads or material failures using current software tools. Design with safety considerations. Use of two and three-dimensional models to study failures. Use of the theory of reliability and forensic engineering to increase product safety.

ME 241. Optimum Mechanical Design. 3 Units
Prerequisite(s): ENGR 201; ENGR 201 may be taken concurrently.
Term Typically Offered: Fall, Spring

Mathematical methods of optimum design using linear and non-linear optimization; constrained and unconstrained optimum design. Optimization of mechanical elements and assemblies to meet design requirements, material characteristics and geometry. Numerical methods and computer usage in optimal design. Application of these principles to realistic design problems.

ME 243. Accident Biomechanics Reconstruction. 3 Units
Term Typically Offered: Fall, Spring

Study of the interaction of the human body kinematics and dynamic biomechanics in accidents involving the work place, activities and vehicles. Impact injury mechanisms, response of the human body using computer models and software analysis tools. Biomechanical response to impact, and tolerance levels. Human factors that influence the biomechanical reactions of people with their vehicles and the environment. Photographic and video analysis, computer graphics, and computer simulations. Forensic engineering to determine the dynamic forces that cause injury in different situations.

ME 250. Heat Transfer: Conduction. 3 Units
Prerequisite(s): ME 126, ENGR 202; ENGR 202 may be taken concurrently.
Term Typically Offered: Fall, Spring

Theory and analytical methods in steady-state and transient heat conduction. Development of the differential equations and initial and boundary conditions. Solutions by separation of variables, transforms, finite differences and integral methods. Heat transfer from extended surfaces.

ME 251. Heat Transfer: Convection. 3 Units
Prerequisite(s): ME 126, ENGR 201; ENGR 201 may be taken concurrently.
Term Typically Offered: Fall, Spring

Analyzes convective heat and mass transfer. Development of the Navier-Stokes and energy equations for two-dimensional flows. Boundary layer theory and numerical techniques in solving convection problems. Analyzes turbulence, transport by Reynold's stresses and Prandtl's mixing length theory.

ME 252. Heat Transfer: Radiation. 3 Units
Prerequisite(s): ME 126, ENGR 202.
Term Typically Offered: Fall, Spring

Fundamentals and basic laws of radiative transfer. Properties of surfaces, spectral characteristics and configuration factors. Radiation transfer between surfaces. Absorbing, emitting and scattering media. Combined conduction, convection and radiation. Applications to solar energy systems.

ME 253. Advanced Fluid Mechanics. 3 Units
Prerequisite(s): ENGR 132, graduate status.
Term Typically Offered: Fall, Spring

Analytical and numerical analysis of Navier-Stokes equations for laminar flow; stability of laminar flow and its transition to turbulence. Analyzes stream functions and the velocity potential, and vorticity dynamics. The mathematical analysis of incompressible turbulent flows; development of Reynolds stress equations, turbulent boundary layer equations, turbulent flow in pipes and channels, and turbulent jets and wakes.

ME 255. Advanced Heat Transfer. 3 Units
Term Typically Offered: Fall, Spring

Advanced topics in heat transfer including analytical and numerical solutions to heat conduction equations in both the steady and unsteady state; use of approximate and analytical techniques for the prediction of convective heat transfer in laminar and turbulent flows, heat transfer in high-velocity flows; analysis of the nature of thermal radiation and radiative heat transfer in enclosures.

ME 256. Mechanics and Thermodynamics of Compressible Flow. 3 Units
Prerequisite(s): ENGR 201 or ENGR 202; ENGR 201 or ENGR 202 may be taken concurrently.
Term Typically Offered: Fall, Spring

Application of the laws of fluid mechanics and thermodynamics to problems of compressible flow in two and three dimensions; small perturbation theory, hodograph method and similarity rules for subsonic flow. Method of characteristics, shock wave analysis for steady, unsteady and supersonic, one-dimensional flows.

ME 258. Advanced Thermodynamics. 3 Units
Prerequisite(s): ENGR 202.
Term Typically Offered: Fall, Spring

Advanced topics in thermodynamics including applications of fundamental postulates to chemical, mechanical, magnetic and electric systems, theory of fluctuations, and irreversible thermodynamics.

ME 259. Introduction to Computational Fluid Dynamics. 3 Units
Prerequisite(s): ENGR 132, ME 105 and ME 126.
Term Typically Offered: Fall, Spring

Fundamentals of computational fluid dynamics, modeling of physical processes, including the fluid flow, heat and mass transfer, and computer skills. Basic concepts of numerical analysis using computer, including the solutions of ordinary and partial differential equations. Basic hands-on experience on using commercial computational fluid dynamics software packages.

ME 270. Advanced Computer-Aided Design of Dynamic Systems. 3 Units
Prerequisite(s): ME 114 or ME 171.
Term Typically Offered: Fall, Spring

Computer analysis, synthesis and modeling of physical systems including single and multiple degree of freedom, and linear/nonlinear systems. Use of Computer-Aided Modeling software (CAMP-G) and Advanced Digital Simulation Languages (ADSL). Design and analysis of multi-energy systems using Block Diagrams, Bond Graphs, and state space equation representation. Design of electromagnetic, electro-hydraulic servomechanisms, actuators and driven systems; introduction to multi-variable control of complex systems; stability, controllability, and observability.

ME 272. Finite Element Modeling in Computer-Aided Design. 3 Units
Prerequisite(s): ME 105, ME 173.
Term Typically Offered: Fall, Spring

Finite-element methods in the analysis and optimal design of machine components, structures, and distributed systems. Generation of FEA models using computers. Theoretical and practical application of a finite element code such as PATRAN to the solution of engineering problems. Topics include static and vibration analysis, stress analysis buckling, normal modes, direct and modal frequency response, transient analysis, and heat transfer.

ME 273. Multibody Dynamics of Rigid and Flexible Systems. 3 Units
Prerequisite(s): Graduate standing.
Term Typically Offered: Fall, Spring

Analysis and design of rigid and flexible multi-body assemblies in two and three dimensions with applications to mechanisms, machinery, ground and space vehicles. Kinematic and kinetic analysis in two and three dimensions; impulsive and impact forces; modes of vibration. Use of solid modeling, dynamic analysis and finite element analysis methods.

ME 274. Introduction to Flight Dynamics. 3 Units
Prerequisite(s): MATH 45, ENGR 110.
Term Typically Offered: Fall, Spring

Review of Laplace Transforms, matrix algebra, and aerodynamics. Derivation of aircraft rigid body equations of motion. Linearization of the equation of motion about reference flight (trim) condition, and separation into longitudinal and lateral equations of motion. Determination of aerodynamic stability derivatives and control effectiveness. Trim analysis, static and dynamic stability and control. Aircraft handling qualities and stability augmentation. Simulation of aircraft response to control and atmospheric inputs.

ME 275. Analysis of Aircraft Structures. 3 Units
Prerequisite(s): Graduate standing.
Term Typically Offered: Fall, Spring

Review of structural analysis: elasticity, virtual work and energy methods, torsion of solid sections, bending of plates, columns. Analysis of aircraft structures: materials, structural components of aircraft, airworthiness, airframe loads, fatigue, structural idealization, fuselages, wings.

ME 276. Advanced Vibration Theory. 3 Units
Prerequisite(s): ME 114, ME 171, or CE 166.
Term Typically Offered: Fall, Spring

Advanced study of mechanical and structural vibrations. Discrete and distributed parameter systems with linear and nonlinear characteristics. Variational principle, Lagrange's equation and finite element method. Matrix equation and eigenvalue problems. Modal analysis and modal testing. Stability and control. Theory developed through physical problems.

ME 278. Space Systems Engineering Management. 3 Units
Prerequisite(s): ENGR 110.
Term Typically Offered: Fall, Spring

Systems Engineering approach to plan and direct engineering projects. Emphasizes systems engineering process, requirement design fundamentals, subsystem fundamentals, trade studies, integration, technical reviews, case studies and ethics. Space exploration used as an example; skills applicable to any engineering project. Project-orientated course to plan the design of space and ground vehicles, satellites, airplanes and multidisciplinary subsystems.

ME 280. Advanced Mechanical Properties of Materials. 3 Units
Prerequisite(s): ME 180
Term Typically Offered: Fall, Spring

Mechanical properties of materials, with special attention to dislocations/ defects and deformation and fracture control mechanisms. Mechanical properties of conventional engineering materials as well as advanced materials such as nanostructured materials are considered. Effects of defects on mechanical behavior at ambient and elevated temperature are discussed with attention given to strengthening mechanisms, creep, fatigue and fracture.

ME 285. Materials for Extreme Environments. 3 Units
Prerequisite(s): ME 180 or PHYS 110
Term Typically Offered: Fall, Spring

Comprehensive study of material applications in extreme environments, with special attention to mechanical, thermal and electronic behavior. Extreme temperature, pressure. corrosive or toxic environments and high rate deformation are considered. Currently available materials as well as emerging materials are explored for specific applications such as undersea, outer space, ballistic, nuclear, combustion, and other extreme application arenas.

ME 295. Fieldwork. 1 - 3 Units
Prerequisite(s): Permission of Graduate Coordinator or Department Chair.
Term Typically Offered: Fall, Spring

Supervised employment in industry or government that provides practical work experience. Requires satisfactory completion of the work assignment and a written report.
Note: Units may not be applied toward meeting the 30-unit requirement of the degree.

Credit/No Credit

ME 296A. Lightweight Materials and Structures. 3 Units
Term Typically Offered: Fall, Spring

An introduction to lightweight materials and lightweight design optimization with an emphasis on mechanical properties, thermal and mechanical processing, and materials selection in lightweight structural design. Topics include aluminum alloys, titanium alloys, magnesium alloys, thermoplastics and thermosets, metal and polymer matrix composites, common lightweight structures, and net shape forming.

ME 296L. Creative Engineering Design for Quality Products. 3 Units
Prerequisite(s): ME 138 and ME 180.
Term Typically Offered: Fall, Spring

Introduction to analytical and systematic design methodologies in creative and quality product design. Topics include product design process, creative conceptual design tools such as axiomatic design, theory of inventive problem solving (TRIZ), and engineering decision making. Quality product design including design of experiments, robust design techniques, and design optimization. Assignments include application of these principals to solving open-ended design problems using computing tools. Two hour lecture; Three hour laboratory.

ME 296M. Space Mission Design and Analyses. 3 Units
Term Typically Offered: Fall, Spring

This course examines the methods of systems design and analyses required to design and optimize the space mission over its life cycle. The process of optimization covers all the major elements of a space mission such as the ground systems, launch vehicles, spacecraft/payload, space environment, in-orbit operation and maintenance, and end-of-life disposal. The optimization of the overall mission must balance between performance, cost and reliability of all the major elements.

ME 296O. Advanced Heat Transfer. 3 Units
Prerequisite(s): ME 126 and ENGR 202.
Corequisite(s): ENGR 202.
Term Typically Offered: Fall, Spring

Advanced topics in heat transfer including analytical and numerical solutions to heat conduction equations in both the steady and unsteady state; use of approximate and analytical techniques for the prediction of convective heat transfer in laminar and turbulent flows, heat transfer in high-velocity flows; analysis of the nature of thermal radiation and radiative heat transfer in enclosures.

ME 296P. Advanced Dynamics. 3 Units
Prerequisite(s): Graduate Standing
Term Typically Offered: Fall, Spring

Newtonian mechanics: Newton's laws, impulse and momentum, work and energy. Analytical mechanics: Degrees of freedom, generalized coordinates, constraints. Lagrange multipliers, principles of virtual work, D'Alembert's principle, Hamilton's principle, Lagrange's equation of motion. Rotating reference frames. Rigid body dynamics: kinematics, linear and angular momentum, and kinetic energy of a rigid body, principle axes, equations of motion. Euler angles. Behavior of dynamic systems: motion about equilibrium points, stability, Lyapunov's direct method. Perturbation techniques: secular terms, Lindstedt's method, Duffing's equation.

ME 296Q. Advanced Solid Modeling. 3 Units
Prerequisite(s): Student must pass ME 116.
Term Typically Offered: Fall, Spring

Advanced topics in computer-aided design for mechanical product design. Reviews on fundamental part and assembly modeling, and engineering drawings. Advanced modeling topics such as surface modeling, top-down assembly, macros and API programming, manufacturing oriented design such as sheet metal, plastic and mold design.

ME 296S. Advanced CAD for Aerospace Applications. 3 Units
Term Typically Offered: Fall, Spring

Design of aerospace systems including profile definition, constraints, operations and visualizations, component design, transformation features, and insertions using advanced CAD software such as CATIA. Creation of complete assembly design including creation of product files, identifying, inserting and displacing components, constraining parts, numbering parts and scene creation. Specifics of sheet metal design for aerospace design including creation of flange, cut-out, joggle, holes, stampings and patterns.

ME 296U. Advanced Computer-Aided Product Design. 3 Units
Prerequisite(s): ENGR 6 and ME 116, or graduate-level status
Term Typically Offered: Fall, Spring

Advanced topics in computer-aided design and applications for mechanical product design. Reviews of fundamental parts, assembly modeling, and engineering drawings. Advanced modeling topics such as surface modeling, design for manufacturing, simulation-based design, top-down assembly, macros and API programming.

ME 296V. Advanced Control System Design. 3 Units
Prerequisite(s): ME 172
Design of Multi-Input/Multi-Output controllers using linear quadratic regulator method and advanced controls architectures. Architectures include Proportional, Proportional Integrator and Proportional Integrator Derivative (filter) schemes. The course also includes Digital Control, Optimal Control, Introduction to Guidance, Navigation and Control techniques.

ME 296W. Accident Biomechanics. 3 Units
Prerequisite(s): ENGR 110
Study of the interaction of human body kinematics and dynamic biomechanics in accidents involving human activities and vehicles. Impact injury mechanisms, response of the human body using computer models and software analysis tools. Biomechanical response to impact, and tolerance levels. Human factors that influence the biomechanical reactions of people with their vehicles and the environment. Photographic and video analysis, computer graphics, and computer simulations. Forensic engineering to determine the dynamic forces that cause injury in different situations.

ME 299. Special Problems. 1 - 3 Units
Term Typically Offered: Fall, Spring

Any properly qualified student who wishes to pursue a problem of his/her own choice may do so if the proposed subject is acceptable to the faculty member with whom he/she works and to his/her advisor.
Credit/No Credit

ME 500. Master's Thesis. 1 - 6 Units
Prerequisite(s): Open to students who have advanced to candidacy and have secured approval of a Thesis proposal form one full semester prior to registration.
Term Typically Offered: Fall, Spring

Completion of a thesis. Credit given upon successful completion of a Master's Thesis (4 - 6 units; maximum 6 units).
Note: Course may be repeated for no more than 6 units total.