Mechanical Engineering

In the College of Engineering

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The undergraduate program in Mechanical Engineering is accredited by ABET, Inc.

Faculty

Emeritus: Bauer, Bedore, Bilterman, Craig, Hoyt, Hussain, Lybarger, Mansfield, Morgan, Murphy, Ohnysty, Rao
Chair: Mehrabadi
Professors: Bhattacharjee, German, Kline, May-Newman, Mehrabadi, Olevsky
Associate Professors: Beyene, Burns, Impelluso, Moon, Morsi
Assistant Professors: Kassegne, Miller
Adjunct: Cornwall

Offered by the Department

Doctor of Philosophy degree in engineering sciences/applied mechanics.
Master of Engineering.
Master of Science degree in bioengineering.
Master of Science degree in mechanical engineering.
Major in mechanical engineering with the B.S. degree.

Transfer Credit

No credit will be given for upper division engineering coursework taken at an institution having an engineering program which has not been accredited by the American Board for Engineering and Technology, unless the student successfully completes the first 12 units of engineering work attempted at this university. At that time, and upon recommendation of the department, credit will be given for the unaccredited work.

General Education

Students will complete a minimum of 50 units in General Education, to include a minimum of nine upper division units taken after attaining junior class standing. No more than 12 units may be used for General Education credit from any one department or academic unit. No more than 7 units from one department can be used in Sections II and IV combined (Foundations of Learning and Explorations of Human Experience), nor more than 10 units from one department in Sections II, III, and IV combined (Foundations of Learning, American Institutions, and Explorations of Human Experience).

I. Communication and Critical Thinking: 9 units
You may *not* use Credit/No Credit grades in this section.
1. Oral Communication (3 units)
2. Composition (3 units)
3. Intermediate Composition and Critical Thinking (3 units)

II. Foundations of Learning: 29 units
A. Natural Sciences and Quantitative Reasoning (17 units):
1. Physical Sciences (10 units)
Engineering students will take Chemistry 202 which includes a laboratory (4 units).
Physics 195 (3 units)
Physics 196 (3 units)
2. Life Sciences (3 units)
3. Laboratory (satisfied under A.1. above)
4. Mathematics/Quantitative Reasoning
Engineering students will take Mathematics 150, 4 units applicable to General Education. You may *not* use Credit/No Credit grades.

B. Social and Behavioral Sciences (3 units)
C. Humanities (9 units)
Complete three courses in three different areas. One of these courses and the one under IV.A. below must be taken in the same department.

III. American Institutions: Three units of the six units of coursework which meet the American Institutions graduation requirement may be used in General Education, excluding courses numbered 500 and above.

IV. Explorations of Human Experience: Courses in this area must not be taken sooner than the semester in which you achieve upper division standing (60 units passed). Upper division courses in the major department may not be used to satisfy General Education. Total: 9 units; must include one course of cultural diversity.

A. Upper division Humanities (3 units)
Three units must be taken from the same department as one of the Humanities courses selected in Foundations of Learning.

B. Upper division Humanities (3 units from a department not selected in A above.)

C. Upper division Social and Behavioral Sciences (3 units)

The Major

Mechanical engineers work on diverse, challenging problems that require the integration of science, engineering, and socioeconomic knowledge. Mechanical engineers develop solutions to physical problems, question how things work, make things work better, and create ideas for doing things in new and different ways. As a mechanical engineering student, you'll cover a broad scope of topics to prepare you for a successful engineering career.

Jobs in mechanical engineering include developing products to improve air and water quality, inventing more efficient energy sources, designing farm equipment to improve crop yield throughout the world, and developing systems for biological research as well as lifesaving medical equipment. A mechanical engineer, now more than ever, is someone who can translate scientific theories into the real products and processes to improve the quality of life.

Mechanical engineers are designers, and the program is dedicated to teaching engineering through the process of design. Design methodology and design projects are integrated throughout the curriculum, culminating in a capstone, design experience in the senior year where students are members of a design team.

The future depends on solving the worldwide problems of energy shortages, environmental pollution, world health, and inadequate food production. Mechanical engineers are actively involved in finding solutions for these problems.

Educational Objectives

The objectives of the mechanical engineering program are:

1. To immerse students in a rigorous academic program that provides them with a strong grounding in the core fundamentals of mechanical engineering, basic science, and mathematics.
2. To instill in students an open minded but critical approach to the analysis of problems and design of systems, keeping in mind the technical, professional, societal, environmental, economic, and ethical dimensions of any solution.
3. To prepare students for successful careers and to have an appreciation of the need for life-long learning in a rapidly changing field.

4. To give students a significant exposure to the humanities and social sciences in order to broaden their appreciation of the world and provide an understanding of the role that engineering plays in society.

Mechanical engineering students will graduate with the following abilities: knowledge of mathematics, science, and engineering; design and conduct experiments, analyze and interpret data; design a system, component, or process to meet desired needs; function on multidisciplinary teams; identify, formulate, solve engineering problems; understanding of professional and ethical responsibility; communicate effectively; understand impact of engineering solutions in a global and societal context; recognition of need for and an ability to engage in life-long learning; knowledge of contemporary issues; techniques, skills, and modern engineering tools necessary for engineering practice; apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations) to model, analyze, design, and realize physical systems, components or processes; work professionally in both thermal and mechanical systems areas.

Major Academic Plans (MAPs)

Visit http://www.sdsu.edu/mymap for the recommended courses needed to fulfill your major requirements. The MAPs Web site was created to help students navigate the course requirements for their majors and to identify which General Education course will also fulfill a major preparation course requirement.

Mechanical Engineering Major

With the B.S. Degree
(Major Code: 09101)

All students in mechanical engineering pursue a common program of basic sciences, engineering, and mechanical engineering fundamentals. The major consists of 52 upper division units. Students are provided with the opportunity to select a pattern of study to satisfy their areas of interest. This pattern of study is indicated in the sequence known as "professional electives" and may be selected from available courses in controls, energy conversion, gas dynamics, heat transfer, machine design, materials, thermodynamics, vibrations, and other areas.

Students must complete all upper division courses in the major within seven years prior to graduation. Students who will have completed any of those courses more than seven years before the projected date of graduation must contact the department chair for information about ways to certify knowledge of current course content.

Preparation for the Major. Mechanical Engineering 101, 102, 203, 240, 241; Chemistry 202; Electrical Engineering 204; Engineering 280; Engineering Mechanics 200, 220; Mathematics 150, 151, 252; Physics 195, 196, 196L, 197. (48 units)

General Education. Engineering students must follow the specific General Education program outlined in this section of the catalog. Other general education requirements and limitations, as well as listings of specific General Education course electives are presented in the General Education section of Graduation Requirements for the Bachelor's Degree.

Graduation Writing Assessment Requirement. Passing the Writing Proficiency Assessment with a score of 10 or above or completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better. See "Graduation Requirements" section for a complete listing of requirements.

Major. A minimum of 51 upper division units to include Mechanical Engineering 304 (or Civil Engineering 301), 310, 314, 330, 340, 350, 351, 452, 490A, 490B, 495, 555; Engineering Mechanics 340, 341. Professional electives: Twelve units of additional coursework may be selected from any 400- or 500-level mechanical engineering course or approved courses from other departments, with a maximum of three units at the 400-level.

Master Plan. The master plan provides an advising record for mechanical engineering majors and should be initiated by the student with their faculty adviser during the second semester of the freshman year. All students must comply with this requirement prior to enrollment in Mechanical Engineering 310. The master plan must be reviewed each semester with the faculty adviser before registration, and submitted to the Office of Advising and Evaluations the semester prior to graduation. All course substitutions must be approved by the department chair.

Courses (M E)

Refer to Curricula and Courses and University Policies sections of this catalog for explanation of the course numbering system, unit or credit hour, prerequisites, and related information.

LOWER DIVISION COURSES

M E 101. Solid Modeling I (2)
Six hours of laboratory.
Computer-aided solid modeling, including engineering documentation, dimensioning and tolerancing per ASME Y14.5M-1004. Elementary sketching and dimensioning of orthographic and pictorial drawings and sections.

M E 102. Solid Modeling II (2)
Six hours of laboratory.
Prerequisite: Mechanical Engineering 101.
Continuation of computer-aided solid modeling and engineering documentation with geometric tolerancing, thread, and thread notations per ASME Y14.5M-1994. Finite element analysis (FEA) of mechanical components.

M E 203. Computer Programming and Applications (2)
Six hours of activity.
Prerequisites: Mechanical Engineering 101 and Mathematics 151. Recommended: Mechanical Engineering 102.
Principles of programming using C and Java. Graphical programming using Labview. Topics include data types, loops, control flow, arrays, memory acquisition, data structures. Applications related to mechanical system components.

M E 240. Introduction to Engineering Materials (3)
Prerequisites: Chemistry 202 and credit or concurrent registration in Engineering Mechanics 200 or 202. **Proof of completion of prerequisites required:** Copy of transcript and evidence of concurrent registration in Engineering Mechanics 200.
Atomic and molecular structure of materials utilized in engineering. Analysis of the relationships between structure of materials and their mechanical, thermal, electrical, corrosion, and radiation properties. Examples of material structure relevant to civil, electrical, aerospace, and mechanical engineering applications.

M E 241. Materials Laboratory (1)
Three hours of laboratory.
Prerequisite: Credit or concurrent registration in Mechanical Engineering 240.
Experimental methods used to characterize engineering materials and their mechanical behavior.

M E 296. Experimental Topics (1-4)
Selected topics. May be repeated with new content. See *Class Schedule* for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree.

UPPER DIVISION COURSES
(Intended for Undergraduates)

NOTE: Proof of completion of prerequisites required for all Mechanical Engineering 300-, 400-, and 500-level courses: Copy of transcript is acceptable as proof. In addition, Mechanical Engineering 351, 490A, and 530 require evidence of concurrent registration in appropriate courses.

M E 304. Mechanics of Materials (3)
Prerequisite: Engineering Mechanics 200.
Concepts of stress and strain. Generalized Hooke's law. Formulations for axial, shear, bending, torsion, and combined stresses applied to tension members, pinned joints, beams, and shafts. Euler buckling criteria for columns. Energy methods. Not open to students with credit in Civil Engineering 301.

M E 310. Engineering Design: Introduction (3)
Two lectures and three hours of guided design activities.
Prerequisites: Mechanical Engineering 102, 203, and Engineering Mechanics 220. Every mechanical engineering student must have a master plan on file before enrolling in Mechanical Engineering 310.
Professional approach to engineering design problems. Problem definition, information gathering, feasibility studies, analysis, final design and communication. Several design studies and projects are completed.

M E 314. Engineering Design: Mechanical Components (3)
Prerequisites: Mechanical Engineering 102, 203, 304 (or Civil Engineering 301).
Application of mechanics, physical properties of materials, and solid mechanics to the design of machine elements. Student design projects.

M E 330. Control Systems Laboratory (3)
Two lectures and three hours of laboratory.
Prerequisites: Mechanical Engineering 203; Electrical Engineering 204; Engineering 280; Engineering Mechanics 220, 340; Linguistics 200 or Rhetoric and Writing Studies 200.
Control theory (e.g. stability, feedback, PID control) with applications in microprocessor-based control of dynamic, vibrational, and mechatronic systems. "Bread-boarding" and BASIC programming of microcontrollers and graphical programming of PC-based controller interfaces.

M E 340. Materials, Manufacturing, and Design (3)
Prerequisites: Mechanical Engineering 240, 241, 304 (or Civil Engineering 301).
Fabrication and thermomechanical processing effects on properties and service behavior of engineering materials. Fracture mechanics and materials behavior under a range of design conditions. Design criteria for engineering materials including fatigue and creep. Case studies and failure analysis techniques.

M E 350. Thermodynamics (3)
Prerequisites: Mathematics 252 and Engineering Mechanics 200.
Basic concepts and principles of thermodynamics with emphasis on simple compressible substances. First and second law analysis, entropy, exergy analysis and state relations.

M E 351. Engineering Thermodynamics (3)
Prerequisites: Mechanical Engineering 350 and credit or concurrent registration in Engineering Mechanics 340.
Analysis and design of gas and vapor power cycles, and refrigeration systems. Generalized property relations for gases and gas-vapor. Air-conditioning. Combustion and chemical equilibrium. Design of engineering systems and processes.

M E 352. Thermodynamics and Heat Transfer (3)
Prerequisites: Engineering Mechanics 200 and Mathematics 252.
First and second laws of thermodynamics; heat conduction, convection and radiation. Not acceptable for mechanical engineering majors.

M E 452. Principles of Heat Transfer (3)
Prerequisites: Mechanical Engineering 350 and Engineering Mechanics 340.
Analytical and numerical solutions of steady and transient one- and two-dimensional conduction problems, forced and natural convection in external and internal flows, and thermal radiation. Applications.

M E 490A-490B. Engineering Design: Senior Project (3-3)
Nine hours of guided design activities.
Prerequisites for 490A: Mechanical Engineering 304 (or Civil Engineering 301), 310, 314, 330, 340, 351, 452. Biology students enrolling in this course must have completed Biology 366, Electrical Engineering 204, Mechanical Engineering 352, and have credit or concurrent registration in Biology 590.
Prerequisites for 490B: Mechanical Engineering 490A, 495, 514. Biology majors: Mechanical Engineering 490A and Biology 590.
Applications of engineering principles and design techniques to the designing, building, and testing of an engineering system. A single project is completed in this two-course sequence and is judged completed upon presentation of an oral and a written report. In addition, issues related to ethics and engineering practice are discussed.

M E 495. Mechanical and Thermal Systems Laboratory (2)
One lecture and three hours of laboratory.
Prerequisites: Mechanical Engineering 310, 330, 351, 452.
Data acquisition theory, instrumentation, sensors, data reduction, statistical and uncertainty analysis, and design of experiments. Experience in designing, performing, and reporting experiments on mechanical and thermal systems, mechanisms, vibrations, structures, thermodynamics, heat transfer.

M E 496. Advanced Mechanical Engineering Topics (1-3)
Prerequisite: Consent of instructor. **Proof of completion of prerequisite required:** Copy of transcript.
Modern developments in mechanical engineering. See *Class Schedule* for specific content. Maximum credit nine units for any combination of Mechanical Engineering 496, 499 and 596.

M E 499. Special Study (1-3)
Prerequisite: Consent of instructor. **Proof of completion of prerequisite required:** Copy of transcript.
Individual study. Maximum credit nine units for any combination of Mechanical Engineering 496, 499 and 596.

UPPER DIVISION COURSES
(Also Acceptable for Advanced Degrees)

NOTE: Proof of Completion of prerequisites required for all Mechanical Engineering 300-, 400-, and 500-level courses: Copy of transcript. In addition, Mechanical Engineering 351, 490A, and 530 require evidence of concurrent registration in appropriate courses.

M E 502. Continuum Mechanics (3)
Prerequisites: Mechanical Engineering 304 (or Civil Engineering 301) and Engineering Mechanics 340.
Mechanics of continua, stress tensor, deformation and flow, constitutive relations. Applications to common solids and fluids

M E 514. Advanced Machine Design (3)
Prerequisites: Mechanical Engineering 314 and 340.
Application of advanced mechanics of materials to design and analysis of mechanical elements. Probabilistic design and finite element methods and applications. Design projects involve extensive use of finite element programs.

M E 520. Introduction to Mechanical Vibrations (3)
Prerequisites: Mechanical Engineering 304 (or Civil Engineering 301) and Mechanical Engineering 330.
Analysis of mechanical vibration; single- and multi-degree of freedom systems; free and forced vibrations; vibration isolation; vibration absorbers. Theory of vibration measuring instruments.

M E 530. Automatic Control Systems (3)
Prerequisite: Mechanical Engineering 330.
Dynamic characteristics of control components and systems. Stability and response of closed loop systems. Design of control systems.

M E 540. Nonmetallic Materials (3)
Prerequisites: Mechanical Engineering 314 and 340.
Fundamentals of ceramics, polymers, and composite materials. Materials design and selection. Statistical methods of brittle materials design, appropriate for ceramic materials, and rheological modeling of polymeric materials. Stress and strain analysis using classical lamination theory of multi-ply composite laminates.

M E 542. Manufacturing with Nonmetallic Materials (3)
Prerequisites: Mechanical Engineering 340 and Engineering 280 with a grade of C or better.
Engineering polymers and composites, processes, and manufacturing techniques. Polymer flow in extrusion, compression molding, RTM, and calendaring. Hands-on fabrication and test exercises included along with a capstone manufacturing project.

M E 543. Powder-Based Manufacturing (3)
Prerequisite: Mechanical Engineering 340.
Manufacturing of micro and nano-structured engineering components and composites starting with metal and/or ceramic powders. Powder production methods, characterization, powder shaping and compaction, sintering, hot consolidation, design considerations, and finishing operations.

M E 546. Computer Aided Manufacturing (3)
Prerequisites: Mechanical Engineering 102, 314, 340; and Engineering 280 with a grade of C or better.
Computer controlled manufacturing and assembly techniques and devices. Databases and special languages. Agile manufacturing soft ware programs and technologies.

M E 552. Heating, Ventilating, and Air-Conditioning (3)
Prerequisites: Mechanical Engineering 351 and 452.
Fundamentals of air conditioning processes, psychrometrics, and building cooling load calculations. Design and analysis of HVAC systems. Equipment selection. Design codes and standards. Computerized cooling load calculations.

M E 555. Thermal Systems Analysis and Design (3)
Prerequisites: Mechanical Engineering 351 and 452.
Analysis, design, and optimization of thermal systems using microcomputers. Modeling of thermal systems and components. Thermal system component characteristics and their effect on overall system performance. Relationship among thermal sciences in design process. Introduction to thermoeconomic optimization.

M E 556. Solar Energy Conversion (3)
Prerequisites: Engineering Mechanics 340, Mechanical Engineering 351 and 452.
Application of thermodynamics, fluid mechanics and heat transfer to the thermal design of solar energy conversion systems. Computer simulations utilized.

M E 580. Biomechanics (3)
Prerequisites: Mechanical Engineering 304 (or Civil Engineering 301) and Engineering Mechanics 340.
Application of engineering methodologies for quantitative understanding of biological/physiological phenomena. Continuum mechanics principles. Cardiovascular system and its components viewed from a mechanistic standpoint.

M E 585. Fundamentals of Micro-Electro-Mechanical Systems (MEMS) (3)
One lecture and four hours of laboratory.
Prerequisites: For aerospace engineering majors: E E 204, E M 220, and M E 240. For electrical engineering majors: E E 330 and M E 240. For mechanical engineering majors: E E 303, E M 220, and M E 240.
Microfabrication techniques, microsensors and microactuators, and scaling laws. A design project of a micro-device including schematic creation, test of performance, layout generation, and layout versus schematic comparison. (Formerly numbered Engineering Mechanics 585.)

M E 596. Advanced Mechanical Engineering Topics (1-3)
Prerequisite: Consent of instructor. **Proof of completion of prerequisite required:** Copy of transcript.
Modern developments in mechanical engineering. May be repeated with new content. See *Class Schedule* for specific content. Maximum credit of nine units for any combination of Mechanical Engineering 496, 499 and 596 applicable to a bachelor's degree. Credit for 596 and 696 applicable to a master's degree with approval of the graduate adviser.

GRADUATE COURSES
Refer to the *Graduate Bulletin*.