Mechanical Engineering

In the College of Engineering

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The undergraduate program in Mechanical Engineering is accredited by the Accreditation Board for Engineering and Technology, Inc.

Faculty

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

Offered by the Department

Doctor of Philosophy degree in engineering sciences/applied mechanics.
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 Accreditation Board for Engineering and Technology, Inc., 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 twelve 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 and Explorations), nor more than 10 units from one department in Sections II, III, and IV combined (Foundations, American Institutions, and Explorations).

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: 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)
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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: 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.
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 invent solutions to problems involving a broad spectrum of thermal/mechanical/electromechanical devices. They create novel devices for solving problems in innovative ways. A newer focus for mechanical engineers is in the area of biomedical engineering, which is the application of quantitative engineering methods to the understanding and solution of biological and physiological problems. Another focus is the design of manufacturing systems. This involves improving quality and speed of manufacture through implementation of computer technology via robots and other automation equipment. Thus, Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), and Computer Integrated Manufacturing (CIM) are all newer aspects of mechanical engineering education.

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.

MECHANICAL ENGINEERING MAJOR

FRESHMAN YEAR

Fall Semester	*Units*	*Spring Semester*	*Units*
M E 101, Solid Modeling I	2	M E 102, Solid Modeling II	2
Chemistry 202, Gen. Chem. for Engrs.	4	Mathematics 151, Calculus II	4
Mathematics 150, Calculus I	4	Physics 195, Principles of Physics	3
General Education	6	General Education	9
	16		18

SOPHOMORE YEAR

Fall Semester	*Units*	*Spring Semester*	*Units*
M E 203, Computer Program. and Applic.	2	CIV E 301, Intro. to Solid Mechanics	3
M E 240, Intro. to Engineering Materials	3	E E 203 or E E 204	
M E 241, Materials Laboratory	1	Principles of Electrical Engineering	3
E M 200, Statics	3	ENGR 280, Methods of Analysis	3
Mathematics 252, Calculus III	4	E M 220, Dynamics	3
PHYS 196 & 196L, Principles of Physics	4	Physics 197, Principles of Physics	3
		General Education	3
	17		18

JUNIOR YEAR

Fall Semester	*Units*	*Spring Semester*	*Units*
M E 310, Engr. Design: Introduction	3	M E 312, Simulation of Engr. Systems	3
M E 340, Materials, Manufact. and Design	3	M E 314, Engr. Design: Mech. Comp.	3
M E 350, Thermodynamics	3	M E 330, Control Systems Laboratory	3
E M 340, Fluid Mechanics	3	M E 351, Engineering Thermodynamics	3
E M 341, Fluid Mechanics Laboratory	1	M E 452, Principles of Heat Transfer	3
General Education	6	General Education	3
	19		18

SENIOR YEAR

Fall Semester	*Units*	*Spring Semester*	*Units*
M E 490A, Engr. Design: Senior Project	2	M E 490B, Engr. Design: Senior Project	2
M E 495, Mechanical & Thermal Sys. Lab.	2	M E 555, Thermal Systems Analysis & Des.	3
M E 514, Advanced Machine Design	3	#Technical/Professional Electives	6
#Technical/Professional Electives	3	General Education	3
General Education	3	American Institutions	3
American Institutions	3		
	16		17

Approved as part of the student's master plan.

Educational Objectives

The objectives of the mechanical engineering program are:

1. 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, economic, and ethical dimensions of any solution.
2. To prepare students for successful careers and to have an appreciation of the need for life-long learning in a rapidly changing field.
3. 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: a strong grounding in the fundamentals; 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 advanced mathematics through multivariate calculus and differential equations; familiarity with statistics and linear algebra; work professionally in both thermal and mechanical systems areas including the design and realization of such systems; be computer literate and Internet competent; and knowledge of chemistry and calculus-based physics.

Mechanical Engineering Major

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

NOTE: Refer to above chart for recommended sequence of courses for the major in mechanical engineering.

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. *The students' choice of elective courses must be made in consultation with their advisers and documented by the filing of an approved master plan during the second semester of their freshman year.*

All mechanical engineering students are required to file a master plan. The purpose of the plan is to facilitate proper academic advice. The plan is to be filed after consultation with a faculty member of the department. Once filed, the plan must be reviewed each semester with the assigned adviser before advanced registration. Transfer students must comply with this requirement prior to enrollment in Mechanical Engineering 310.

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.

Graduation Writing Assessment Requirement. Completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better, or passing the Writing Proficiency Assessment with a score of 10 or above. See page 73 in "Graduation Requirements" section for a complete listing of requirements.

Courses (M E)

Refer to Courses and Curricula 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 activity.

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. (Formerly numbered Engineering 190.)

M E 102. Solid Modeling II (2)

Six hours of activity.

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. (Formerly numbered Engineering 195.)

M E 203. Computer Programming and Applications (2) I

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. (Formerly numbered Mechanical Engineering 290.)

M E 205. Simulation of Physical Systems (2) II

Six hours of activity.

Prerequisites: Mechanical Engineering 102, 203, Mathematics 252.

Mechanical mechanisms and dynamic simulation analyses. Construction of web-based virtual machines which operate according to physics. Typical machines include roller coaster, machining center, gear assemblies, stress testing devices, crane and bridges. Network communication software used to connect virtual machines using Java3D. (Formerly numbered Mechanical Engineering 295.)

M E 240. Introduction to Engineering Materials (3) I, II

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. (Formerly numbered Mechanical Engineering 260.)

M E 241. Materials Laboratory (1) I, II

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, 390, 490A, and 530 require evidence of concurrent registration in appropriate courses.

M E 310. Engineering Design: Introduction (3) I, II

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 312. Simulation of Engineering Systems (3) I, II

Prerequisites: Mechanical Engineering 203, 350; Civil Engineering 301; Electrical Engineering 203; Engineering 280; Engineering Mechanics 340.

Modeling, simulation, and analysis of various mechanical systems: dynamic, vibrational, electromechanical, thermodynamic, and fluidic. Circuits for monitoring and controlling mechanical systems. (Formerly numbered Mechanical Engineering 512.)

M E 314. Engineering Design: Mechanical Components (3) I, II

Prerequisites: Mechanical Engineering 310 and 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) I, II

Two lectures and three hours of laboratory.

Prerequisites: Mechanical Engineering 203; Electrical Engineering 203; 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) I, II

Prerequisites: Mechanical Engineering 240, 241; 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) I, II

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) I, II

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. (Formerly numbered Mechanical Engineering 450.)

M E 352. Thermodynamics and Heat Transfer (3) I, II

Prerequisites: Engineering Mechanics 200 or 202 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) I, II

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. (Formerly numbered Mechanical Engineering 470.)

M E 490A-490B. Engineering Design: Senior Project (2-2) I, II

Six hours of guided design activities.

Prerequisites for 490A: Mechanical Engineering 312, 314, 330, 340, 351, 452. Biology students enrolling in this course must have completed Biology 366, Civil Engineering 301, Electrical Engineering 203, 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) I, II

One lecture and three hours of laboratory.

Prerequisites: Mechanical Engineering 314, 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) I, II

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) I, II

Prerequisite: Consent of instructor. **Proof of completion of prerequisite required:** Copy of transcript.

Individual study. Maximum credit six 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, 390, 490A, and 530 require evidence of concurrent registration in appropriate courses.

M E 514. Advanced Machine Design (3) I, II

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. (Formerly numbered Mechanical Engineering 510.)

M E 520. Introduction to Mechanical Vibrations (3)

Prerequisites: Mechanical Engineering 312 and Civil Engineering 301.

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 312.

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 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. (Formerly numbered Mechanical Engineering 582.)

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. (Formerly numbered Mechanical Engineering 570.)

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. (Formerly numbered Mechanical Engineering 586.)

M E 580. Biomechanics (3)

Prerequisites: 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. (Formerly numbered Mechanical Engineering 590.)

M E 596. Advanced Mechanical Engineering Topics (1-3) I, II

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 of six units for any combination of Mechanical Engineering 496, 499 and 596 applicable to a bachelor's degree. Maximum combined credit of six units of Mechanical Engineering 596 and 696 applicable to a 30-unit master's degree.

GRADUATE COURSES
Refer to *Bulletin of the Graduate Division*.