Mechanical Engineering

College of Engineering (http://coe.berkeley.edu)
Department Office: 6141 Etcheverry Hall, (510) 642-1338

Chair: David A. Dornfeld, PhD
Department Website: Mechanical Engineering (http://me.berkeley.edu)

Overview

Mechanical engineers contribute to society by solving problems in transportation, energy, the environment, and human health. The mechanical engineer needs a thorough preparation in mathematics, physics, chemistry, manufacturing processes, properties of materials, mechanics, fluid mechanics, thermodynamics, as well as intensive design and laboratory experience. The program of study includes basic subjects common to all engineering fields, fundamental subjects important to all mechanical engineers and specialization in one or more phases of mechanical engineering.

Undergraduate Program

The freshman and much of the sophomore years of the program emphasize mathematics, physics, chemistry, computing, graphics, materials, and statics. Students are introduced to the profession of engineering in their freshman year in Engineering 10 and first exposed to engineering design in their sophomore year in Engineering 28. In their freshman year students are also introduced, in Engineering 7, to solving engineering problems using computers. Part of the sophomore and much of the junior year curricula focus on engineering science. The sophomore and junior year courses Mechanical Engineering 40, C85, 104, 106, 108, and Electrical Engineering and Computer Sciences 100 are engineering science courses covering dynamics, fluid mechanics, strength of materials, and thermodynamics, with elements of design and computing included. They also introduce students to the use of engineering concepts as tools to analyze component and system performance. From this solid foundation, a student synthesizes tools from different engineering sciences and applies them to design problems. This is the rationale for placing much of the design component of the program in the senior year. Specialization may be provided in the choice of technical electives from the subject areas of applied mechanics, automatic controls, electrochemical systems, energy conversion, fluid mechanics, heat transfer, manufacturing systems, materials processing, mechanical design, cryogenics, robotics and automation, bioengineering, and environmental engineering.

Because of the widening range of technical problems and the limited amount of specialization available in the undergraduate curriculum, qualified students should consider graduate study to expand their scientific and technological capability. Further details on undergraduate and graduate fields of emphasis in mechanical engineering are available in the College of Engineering Undergraduate Guide. (http://coe.berkeley.edu/guide)

Curriculum Overview

Course	Fall	Spring
Freshman Year		
Chemistry 1A and 1AL-General Chemistry or Chemistry 4A-General Chemistry and Quantitative Analysis[1] (p.)	4	-
E 7-Introduction to Computer Programming for Scientists & Engineers	-	4
Engineering 10-Engineering Design and Analysis[2] (p.) [6] (p.)	3	-
Mathematics 1A-Calculus	4	-
Mathematics 1B-Calculus	-	4
Physics 7A-Physics for Scientists and Engineers	-	4
Reading and Composition Course from List A[3] (p.)	4	-
Reading and Composition Course from List B[3] (p.)	-	4
Optional Freshman Seminar or E 92 (Survey Course)	*1*	*1*
Total	**15-16**	**16-17**
Sophomore Year		
Engineering 28-Graphic Communication in Engineering	3	-
Mathematics 53-Multivariable Calculus	4	-
Mathematics 54-Linear Algebra and Differential Equations	-	4
ME 40-Thermodynamics	-	3
ME C85-Introduction to Solid Mechanics	-	3
Physics 7B-Physics for Scientists and Engineers	4	-
Additional Humanities/Social Science Courses[3] (p.)	3-4	3-4
Total	**14-15**	**13-14**
Junior Year		
EE 100-Electronic Techniques for Engineering	-	4

ME 104-Engineering Mechanics II (Dynamics)	3	-
ME 106-Fluid Mechanics	3	-
ME 108-Mechanical Behavior of Engineering Materials	4	-
ME 109-Heat Transfer	-	3
ME 132-Dynamic Systems and Feedback	-	3
Technical Electives[4 (p.)]	3	3
Additional Humanities/ Social Science Courses[3 (p.)]	3-4	3-4
Total	**16-17**	**16-17**
Senior Year		
ME 102A-Experimentation and Measurement	4	-
ME 102B-Mechanical Engineering Design	-	3
ME 107-Mechanical Engineering Laboratory	-	3
Technical Electives[4 (p.)]	6	6
Free Electives[5 (p.)]	3-4	3
Total	**13-14**	**15**

Notes

[1] Chemistry 4A is for students intending a major in Chemistry or Chemical Engineering.

[2] If the prerequisites are met, students may take E 7 in Fall and E 10 in Spring. (See E 7 readiness exam online (http://coe.berkeley.edu/E7))

[3] The Humanities/Social Science (H/SS) requirement includes two approved reading and composition courses and four additional approved courses, with which a number of specific conditions must be satisfied. Reading and Composition "A" and "B" must be completed by no later than the end of the sophomore year. The remaining courses may be taken at any time during the program. See coe.berkeley.edu/hssreq for complete details and a list of approved courses.

[4] Technical Electives: 18 units of technical electives are required, of which at least 15 must be upper-division mechanical engineering courses. Of these 15 units, 3 units must be a design course selected from the following list:
- E 128*-Advanced Engineering Design Graphics
- ME 101-High Mix/Low Volume Manufacturing
- ME 110-Introduction to Product Development
- ME C117-Structural Aspects of Biomaterials
- ME 119-Introduction to MEMS
- ME 128-Computer-Aided Mechanical Design
- ME 130-Design of Planar Machinery
- ME 135-Design of Microprocessor-Based Mechanical Systems
- ME 146-Energy Conversion Principles
- ME 165-Ocean-Environment Mechanics
- ME C176-Orthopedic Biomechanics

Also, one of the technical elective courses must be taken from the quantitative science list below:
- E 117*-Methods of Engineering Analysis
- E 177*-Advanced Programming with MATLAB
- Math 128A*-Numerical Analysis
- ME 120-Computational Biomechanics Across Multiple Scales
- ME C180-Engineering Analysis Using the Finite Element Method

Any upper division course taught by mechanical engineering faculty may be used as part of the 15 units of upper-division mechanical engineering courses. In addition, any course listed above with an asterisk (*) can count toward the 15 unit upper division ME course requirement. Students may receive up to three units of technical elective credit for work on a research project in either ME 196 (Undergraduate Research) or ME H194 (Honors Undergraduate Research-restrictions apply). The other three (3) technical elective units can be chosen from courses in engineering, physical science, mathematics, or statistics. Physical science is defined to include physics, chemistry, biochemistry, chemical engineering, and the biological sciences. Only one lower division course, chosen from the approved list below, can be used to satisfy part of the technical elective requirement. This list consists of the following courses: Any lower division technical course required by another major in the College of Engineering; Astronomy 7A; Biology 1A, 1B; Chemistry 1B, 3A; Civil Engineering 70; Engineering 45; Molecular and Cell Biology 11, 32 (32L not required); and Statistics 20.

Technical Electives cannot include any course taken on a P/NP basis; courses numbered 24, 39, 84; BioE 100; CS C79, CS 195, CSH195; Engin 125, 130AC, 140; IEOR 190 series; IEOR 191; ME 191AC, 190K, 191K.

[5] Free electives can be any technical or non-technical course. A course of your interest offered by any department at Cal; there are no restrictions.

[6] Junior Transfer admits are exempt from completing Engin 10.

* A minimum of 120 units is required for graduation.

Technical Electives

The following groups of elective courses should help undergraduates focus on their specific professional goals. The electives need not be from any single group. For the most current list, please see this webpage. (http://me.berkeley.edu/StudentAffairs/Courses/TechnicalElectives.html)

Biomechanical Engineering:
Biology 1A; EE C145B, C145L C145M; Intergrative Biology 131, 132; ME C115, C117, 127, 133, 134, 135, C176, Molecular and Cell Biology*, 130

Combustion:
CE 111; Chem E 140, 141, 142; E 117; ME 140, 151

Computer-Aided Engineering:
E 128, 177; ME 128

Controls:
E 177; EE 120; ME 133, C134, 135, 146, 175, 190L, 190Y.

Energy:
EE 134, 137A, 137B; ME 140, 146

Environmental Engineering:
CE 111, 173, 175; ME 110, 140, 151, 165, 173; NE 162; Suggested non-technical courses: Architecture 100A, 100B, 140; Geography 144

Fluid Mechanics and Aeronautics:
E 117; CE 131; ME 133, C134, 151, 163, 165, 167, 173, 175, 185

General Mechanical Engineering:
E 117, 128; ME 110, 133, C134, 165, 173, 175, 190A

Heat and Mass Transfer:
Chem E 150B, 171; E 117; ME 140, 151

Materials Processing and Manufacturing Management:
E 120; ME 101, 110, 122, 127, 128, 133, C134, 151, 190A

Mechanical Engineering Design:
E 128; ME 110, 118, 119, 127, 128, 130, 133, C134, 135, 151, 165, C176

Mechatronics:
ME 101, 128, 130, 133, C134, 135

Microelectromechanical systems (MEMS):
ME 118, 119, 138

Nuclear Engineering:
ME C134, 151, 173; NE 101, 120, 150; Physics 137A

Ocean Engineering:
ME 101, 127, 128, C134, 164, 165, 167; CE 120, 180

Robotics and Automation:
EE C125; ME 101, 133, C134, 135, 170, 175

Theoretical and Applied Mechanics:
E 117; Mathematics 104; ME 127, 133, C134, 163, 165, 170, 173, 175, C180, 185

* ME students are not required to take Molecular and Cell Biology 32L with Molecular and Cell Biology 32.

The BS program is accredited in mechanical engineering by the Engineering Accreditation Commission of ABET, Inc., 111 Market Place, Suite 1050, Baltimore, MD 21202-4012; (410) 347-7700.

Mechanical Engineering Minor

The department offers a minor in mechanical engineering that is open to all students not majoring in ME who have completed the necessary prerequisites for the minor requirements. Information is available on the department's website (http://me.berkeley.edu) .

Graduate Programs

Both master's and doctoral programs are available. The student may choose either a scientific emphasis in particular areas or integrated

studies directed to professional objectives. Master of Science and PhD degrees are the relevant degrees for the scientific emphasis, and the MEng and DEng degrees for the professional one. The department also offers a program leading to dual degrees in Master of Science in Engineering and Master of Public Policy. Specialization is offered in the following mechanical engineering disciplines:

1. Controls and dynamics
2. Design
3. Fluids
4. Mechanics
5. Materials
6. Energy science and technology

Specialization is also offered in the following focus areas:

1. Bioengineering
2. Manufacturing
3. Micro-electromechanical systems (MEMS) and nanoengineering
4. mechatronics
5. Energy and environment
6. Ocean engineering

Details on various aspects of graduate study are available here (http://me.berkeley.edu) and from the College of Engineering website.

Note: In addition to the courses listed below, the Department of Mechanical Engineering offers the following courses, found in the Engineering section of this Bulletin: 10, Engineering Design and Analysis; 28, Graphic Communication in Engineering; 117, Methods of Engineering Analysis; 128, Advanced Engineering Design Graphics; 177, Advanced Programming with MATLAB; 191, Engineering Ethics; 193, *California Engineer* Staff; 230A, Engineering Analysis; 230B, Engineering Analysis; 231, Mathematical Methods in Engineering; 266A, Finite Difference Methods for Fluid Dynamics; 266B, Spectral Methods for Fluid Dynamics.

MEC ENG 24 Freshman Seminars 1 Unit
Department: Mechanical Engineering
Course level: Undergraduate
Terms course may be offered: Fall and spring
Grading: The grading option will be decided by the instructor when the class is offered.
Hours and format: 1 hour of Seminar per week for 15 weeks.
The Berkeley Seminar Program has been designed to provide new students with the opportunity to explore an intellectual topic with a faculty member in a small-seminar setting. Berkeley Seminars are offered in all campus departments, and topics vary from department to department and semester to semester.
Course may be repeated for credit as topic varies. Course may be repeated for credit when topic changes.

MEC ENG 40 Thermodynamics 3 Units
Department: Mechanical Engineering
Course level: Undergraduate
Terms course may be offered: Fall, spring and summer
Grading: Letter grade.
Hours and format: 3 hours of Lecture and 1 hour of Discussion per week for 15 weeks. 4.5 hours of Lecture and 1.5 hours of Discussion per week for 10 weeks.
Prerequisites: Chemistry 1A, Engineering 7, Mathematics 1B, and Physics 7B.
This course introduces the fundamentals of energy storage, thermophysical properties of liquids and gases, and the basic principles of thermodynamics which are then applied to various areas of engineering related to energy conversion and air conditioning.
Students will receive no credit for 40 after taking 105B.

MEC ENG C85/CIV ENG C30 Introduction to Solid Mechanics 3 Units
Department: Mechanical Engineering; Civil and Environmental Engineering
Course level: Undergraduate
Terms course may be offered: Fall, spring and summer
Grading: Letter grade.
Hours and format: 3 hours of lecture and 1 hour of discussion per week. 4.5 hours of lecture and 1.5 hours of discussion per week for 10 weeks. 7.5 hours of lecture and 2.5 hours of discussion per week for 6 weeks.
Prerequisites: Mathematics 53 and 54 (may be taken concurrently); Physics 7A.
A review of equilibrium for particles and rigid bodies. Application to truss structures. The concepts of deformation, strain, and stress. Equilibrium equations for a continuum. Elements of the theory of linear elasticity. The states of plane stress and plane strain. Solution of elementary elasticity problems (beam bending, torsion of circular bars). Euler buckling in elastic beams.
Instructors: Armero, Papadopoulos, Zohdi

MEC ENG 98 Supervised Independent Group Studies 1 - 4 Units
Department: Mechanical Engineering
Course level: Undergraduate
Terms course may be offered: Fall, spring and summer
Grading: Offered for pass/not pass grade only.
Hours and format: Hours to be arranged.
Prerequisites: Consent of instructor.
Organized group study on various topics under the sponsorship and direction of a member of the Mechanical Engineering faculty.
Course may be repeated for credit. Course may be repeated for credit when topic changes.

MEC ENG 101 High Mix/Low Volume Manufacturing 3 Units
Department: Mechanical Engineering
Course level: Undergraduate
Terms course may be offered: Fall and summer
Grading: Letter grade.