

Mechanical Engineering

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Mechanical engineering is among the most diversified of the traditional engineering disciplines. The mechanical engineer builds machines to extend our physical and mental capabilities and to convert traditional and novel energy sources into useful forms.

The role of the mechanical engineer has changed dramatically over the past few decades with the extensive use of high-performance computers (in such areas as computational fluid dynamics, materials design, control, and manufacturing), the interfacing of microelectromechanical systems and actuators via microprocessors to build high-precision sensors and devices, and the advent of advanced materials (e.g., composites, shape-memory alloys, ceramics, and superconductors) for new applications (e.g., coatings, biomaterials, and computer storage). These areas offer mechanical engineering students special opportunities for creativity, demanding that they learn not only in depth but also in breadth. Demands for increased energy efficiency and reduced environmental impact—as might be realized, for example, in novel gas turbine or electric hybrid vehicles—require that students understand the fundamentals of mechanics, thermodynamics, fluid mechanics, combustion, and materials science. In all these tasks, the utmost consideration of the modern mechanical engineer is improving the quality of human life. The engineer must also be constantly aware both of the finiteness of Earth’s resources and its environment and of the burden that engineering places on them.

The educational mission of the Department of Mechanical Engineering is to provide an excellent education that will prepare students to become members of the next generation of mechanical engineers. To implement this mission, the department adheres to the following set of educational objectives: to provide a balanced technical and nontechnical education to enable graduates to enter highly selective graduate schools and/or to pursue technical careers in industry or government laboratories; to enable graduates to improve and adapt their skills to accommodate rapid technological changes; to prepare graduates to communicate effectively and to understand the ethical responsibilities and impact on society of their profession. To achieve these objectives, the following fundamental educational goals have been established for the Department of Mechanical Engineering: to provide a comprehensive introduction to basic science and mathematics, which form the foundation of mechanical engineering; to provide thorough training in analytical and experimental methods and in data analysis, including problem formulation; to provide instruction in the fundamentals of the design process, including project innovation, synthesis, and management, both individually and in a team setting; to provide both a technical and a nontechnical program of study in which oral and written communication skills are developed; and to instill in students an understanding of their professional and ethical responsibilities, which affect society and their profession.

COURSES FOR NONMAJORS

Mechanics and mechanical engineering content can be found in several courses intended for those not majoring in science. See Engineering and Applied Science.

THE MECHANICAL ENGINEERING PROGRAM

At Yale, three mechanical engineering programs are offered: a B.S. degree program with a major in Mechanical Engineering, a B.S. degree program with a major in Engineering Sciences (Mechanical), and a B.A. degree program with a major in Engineering Sciences (Mechanical). Prospective majors in both B.S. programs are advised to complete introductory physics and mathematics through calculus (MATH 1150) by the end of their first year.

A student's undergraduate engineering program may include one or more special project courses MENG 4991 or MENG 4992 in which the student pursues a particular research interest through design-oriented projects and experimental investigations. Projects may be initiated by the student, may be performed in a team, or may be derived from the ideas of faculty members who place undergraduates in their ongoing research projects. All interested students should contact the director of undergraduate studies (DUS) for more information on special project courses.

B.S. degree program in Mechanical Engineering This is the most technically intensive mechanical engineering degree program and is accredited by the Engineering Accreditation Commission of ABET, Inc. This program is appropriate for students who plan careers as practicing engineers in industry, consulting firms, or government, as well as for students who are considering a career in research and plan to pursue an advanced degree in engineering.

B.S. degree program in Engineering Sciences (Mechanical) This non-ABET degree program is suitable for students who wish to gain significant expertise within mechanical engineering while combining their engineering studies with related disciplines. For example, a number of students have taken courses in architecture while pursuing a program in mechanical engineering that emphasizes structural mechanics; similarly, a student with an interest in computer graphics might combine engineering courses in computer-aided design with programming courses from the Department of Computer Science.

B.A. degree program in Engineering Sciences (Mechanical) In a society with increasing levels of technical sophistication, a well-rounded individual must have some background in science and technology. The non-ABET B.A. program is designed for students who may be planning careers in business, law, economics, medicine, journalism, or politics but need to understand the impact that science and technology can have on society at large. An understanding of engineering methods and practices, combined with a traditional liberal arts education, provides a strong background for a variety of careers. The program is well suited for students who wish to fulfill the requirements of two majors.

The major for all three degree programs requires a group of prerequisites or equivalents; several courses beyond the prerequisites; and a senior requirement, as indicated below.

PREREQUISITES

B.S. degree program in Mechanical Engineering The prerequisites in mathematics are MATH 1120, MATH 1150, and ENAS 1510, or the equivalent. The basic science prerequisites are PHYS 1800, PHYS 1810, or PHYS 2000, PHYS 2010; one laboratory from PHYS 1650L or PHYS 2050L, and one from PHYS 1660L or PHYS 2060L, or equivalents, and one introductory lecture course in chemistry, numbered CHEM 1610 or higher. The chemistry lecture course may be waived for a Chemistry AP score of 4 or 5 or an IB Higher level or Standard level score of 6 or 7.

B.S. degree program in Engineering Sciences (Mechanical) The prerequisites in mathematics are MATH 1120, MATH 1150, and ENAS 1510, or the equivalent. The basic science prerequisites are PHYS 1800, PHYS 1810, or PHYS 2000, PHYS 2010; one laboratory from PHYS 1650L or PHYS 2050L, and one from PHYS 1660L, PHYS 2060L, or MENG 2616L.

B.A. degree program in Engineering Sciences (Mechanical) The prerequisites in mathematics are MATH 1120 and MATH 1150. The basic science prerequisite is physics at least to the level of PHYS 1700, PHYS 1710.

REQUIREMENTS OF THE MAJOR

See Links to the attributes indicating courses approved for the Mechanical Engineering major requirements.

B.S. degree program in Mechanical Engineering requires twenty courses for 19.5 credits beyond the prerequisites as follows:

1. Advanced mathematics: ENAS 1940 and MATH 2220 or MATH 2250
2. Mechanical engineering and related: MENG 1105, 2511, 2311, 2615, MENG 2616L, 3125, 3422, MENG 3423L, 3323, 3424, MENG 3020L, MENG 4137L and MENG 4138L (the senior requirement), ENAS 1300, ECE 2000
3. Technical electives: three approved technical electives chosen in consultation with the DUS; only one course from MENG 4991 or MENG 4992 may be counted as one of the three technical electives.

The curriculum in this program is arranged in prescribed patterns, but some departures from it are possible with approval of the DUS.

B.S. degree program in Engineering Sciences (Mechanical) The major requires twelve approved course credits in engineering (with only one course from MENG 4991 or MENG 4992), beyond the prerequisites and including the senior project, which can cover a broad array of topics within the subject, provided that they contribute to a coherent program. Students should consult with the DUS at the beginning of their sophomore year.

B.A. degree program in Engineering Sciences (Mechanical) The program requires eight approved course credits in engineering (with only one course from MENG 4991 or MENG 4992), beyond the prerequisites, including the senior project. Students should consult with the DUS at the beginning of their sophomore year.

Credit/D/Fail No course taken Credit/D/Fail may be applied toward the requirements of the major, including prerequisites.

Outside credit Courses taken at another institution or during an approved summer or term-time study abroad program may count toward the major requirements with DUS approval

SENIOR REQUIREMENT

B.S. degree program in Mechanical Engineering Students satisfy the senior requirement by taking MENG 4137L (full-credit) and MENG 4138L (half-credit) in the senior year.

B.S. degree program in Engineering Sciences (Mechanical) Students satisfy the senior project requirement by completing MENG 4154; MENG 4991 or MENG 4992; or another upper-level design course (taken during the senior year) chosen in consultation with the DUS. Only one Special Projects Course (MENG 4991 or 4992) may be counted toward the requirements of the major.

B.A. degree program in Engineering Sciences (Mechanical) Students satisfy the senior project requirement by completing MENG 4991 or MENG 4992; or another upper-level design course (taken during their senior year) chosen in consultation with the DUS. Only one Special Projects Course (MENG 4991 or 4992) may be counted toward the requirements of the major.

SUMMARY OF MAJOR REQUIREMENTS

MECHANICAL ENGINEERING, B.S.

Prerequisites MATH 1120, MATH 1150, and ENAS 1510, or equivalent; PHYS 1800, PHYS 1810, or PHYS 2000, PHYS 2010, and 2 labs (1 from PHYS 1650L or PHYS 2050L; 1 from PHYS 1660L or PHYS 2060L, or equivalents), and 1 introductory chemistry lecture course or equivalent

Number of courses 20 courses and 19.5 credits beyond prerequisites (including senior req)

Specific courses required ENAS 1300 and 1940; ECE 2000; MATH 2220 or MATH 2250; MENG 1105, 2511, 2311, 2615, MENG 2616L, 3125, 3422, MENG 3423L, 3323, 3424, MENG 3020L

Distribution of courses 3 technical electives chosen in consultation with DUS (only one of MENG 4991 or MENG 4992)

Substitution permitted With DUS approval

Senior requirement MENG 4137L and MENG 4138L taken in senior year

ENGINEERING SCIENCES (MECHANICAL), B.S.

Prerequisites MATH 1120, MATH 1150, and ENAS 1510, or equivalent; PHYS 1800, PHYS 1810, or PHYS 2000, PHYS 2010, and 2 labs (1 from PHYS 1650L or PHYS 2050L; 1 from PHYS 1660L, PHYS 2060L, or MENG 2616L)

Number of courses 12 course credits beyond prerequisites (incl senior req)

Substitution permitted With DUS approval

Senior requirement MENG 4154; MENG 4991 or MENG 4992; or another upper-level design course chosen in consultation with the DUS

ENGINEERING SCIENCES (MECHANICAL), B.A.

Prerequisites MATH 1120, MATH 1150; PHYS 1700, PHYS 1710 or higher

Number of courses 8 course credits beyond prerequisites (incl senior req)

Substitution permitted With DUS approval

Senior requirement MENG 4991 or MENG 4992; or another upper-level design course chosen in consultation with the DUS

FACULTY OF THE DEPARTMENT OF MECHANICAL ENGINEERING AND MATERIALS SCIENCE

Professors Ira Bernstein (*Emeritus*), Aaron Dollar, Juan Fernández de la Mora, Alessandro Gomez, [†]Sohrab Ismail-Beigi, [†]Shun-Ichiro Karato, Marshall Long (*Emeritus*), Corey O'Hern, [†]Vidvuds Ozolins, [†]Brian Scassellati, Jan Schroers, Udo Schwarz (*Chair*), Mitchell Smooke

Associate Professors Rebecca Kramer-Bottiglio, Madhusudhan Venkadesan

Assistant Professors Ian Abraham, Yimin Luo, Amir Pahlavan, Bauyrzhan Primkulov, Daniel Wiznia

Senior Lecturer Beth Anne Bennett

Lecturers Lawrence Wilen, Joseph Zinter

[†]A joint appointment with primary affiliation in another department or school.