

Materials Science and Engineering, B.S.

Program Educational Objectives: Graduates of the Materials Science and Engineering program will (1) establish a productive Materials Science and Engineering career in industry, government or academia; (2) apply critical reasoning and the requisite analytical/quantitative skills in seeking solutions to materials science and engineering problems; (3) promote innovation in materials discovery, development and design through effective leadership, skilled communications, and multidisciplinary teamwork; (4) exhibit a commitment to engineering ethics, environmental stewardship, continued learning, and professional development.

(Program educational objectives are those aspects of engineering that help shape the curriculum; achievement of these objectives is a shared responsibility between the student and UCI.)

Since the beginning of history, materials have played a crucial role in the growth, prosperity, security, and quality of human life. In fact, materials have been so intimately related to the emergence of human culture and civilization that anthropologists and historians have identified early cultures by the name of the significant materials dominating those cultures. These include the stone, bronze, and iron ages of the past. At the present time, the scope of materials science and engineering has become very diverse; it is no longer confined to topics related to metals and alloys but includes those relevant to ceramics, composites, polymers, biomaterials, nanostructures, intelligent materials, and electronic devices. In addition, present activities in materials science and engineering cover not only areas whose utility can be identified today, but also areas whose utility may be unforeseen. The services of materials scientists and engineers are required in a variety of engineering operations dealing, for example, with emerging energy systems, design of semiconductors and optoelectronic and nano devices, development of new technologies based on composites and high-temperature superconductivity, biomedical products, performance (e.g., quality, reliability, safety, energy efficiency) in automobile and aircraft components, improvement in nondestructive testing techniques, corrosion behavior in refineries, radiation damage in nuclear power plants, and fabrication of advanced materials.

The undergraduate major in Materials Science and Engineering (MSE) provides students with a thorough knowledge of basic engineering and scientific principles. The undergraduate curriculum in MSE includes (a) a core of Chemistry, Physics, and Mathematics; (b) basic Engineering courses; (c) Materials and Engineering core; and (d) technical courses in Materials Science, Engineering, and Sciences.

Because of the interdisciplinary nature of MSE and its intimate relations with other Engineering disciplines (Aerospace, Biomedical, Chemical, Civil, Computer, Electrical, Environmental, and Mechanical Engineering), qualified students will be able to satisfy in a straightforward manner the degree requirements of their Engineering major and the MSE major.

High School Students: See School Admissions (<http://catalogue.uci.edu/thehenrysamuelischoolofengineering/#undergraduatestudytext>) information.

Transfer Students: Preference will be given to junior-level applicants with the highest grades overall, and who have satisfactorily completed the following **required** courses: two years of approved calculus, one year of calculus-based physics with laboratories (mechanics, electricity and magnetism), completion of lower-division writing, one year of general chemistry (with laboratory), and one course in introductory programming. For course equivalency specific to each college, visit <https://assist.org>.

Students are encouraged to complete as many of the lower-division degree requirements as possible prior to transfer. Students who enroll at UCI in need of completing lower-division coursework may find that it will take longer than two years to complete their degrees. For further information, contact The Henry Samueli School of Engineering at 949-824-4334.

All students must meet the University Requirements (<http://catalogue.uci.edu/informationforadmittedstudents/requirementsforabachelorsdegree/>).

All students must meet the School Requirements (<http://catalogue.uci.edu/thehenrysamuelischoolofengineering/#schoolrequirementstext>).

Major Requirements

Mathematics and Basic Science Courses:

Core Courses:

ENGR 1A or CHEM 1A	General Chemistry for Engineers General Chemistry
CHEM 1B- 1C	General Chemistry and General Chemistry
CHEM 1LC	General Chemistry Laboratory
MATH 2A- 2B	Single-Variable Calculus and Single-Variable Calculus
MATH 2D	Multivariable Calculus
MATH 3A	Introduction to Linear Algebra
MATH 3D	Elementary Differential Equations
MATH 2E	Multivariable Calculus

PHYSICS 7C- 7LC	Classical Physics and Classical Physics Laboratory
PHYSICS 7D- 7E	Classical Physics and Classical Physics
PHYSICS 7LD	Classical Physics Laboratory
Engineering Topics Courses:	
Core Courses:	
MSE 60	Laboratory in Synthesis and Characterization of Materials
MSE 69	Electronic and Optical Properties in Materials
MSE 151	Polymeric Materials
MSE 155	Mechanical Behavior and Design Principles
MSE 155L	Mechanical Behavior Laboratory
MSE 158	Ceramic Materials for Sustainable Energy
MSE 164	X-ray Diffraction, Electron Microscopy, and Microanalysis
MSE 164L	X-ray Diffraction, Electron Microscopy, and Microanalysis Lab
MSE 165A	Thermodynamics of Materials
MSE 165B	Diffusion and Heat Transport in Materials
MSE 165C	Materials Kinetics and Phase Transformations
MSE 165CL	Laboratory in Materials Kinetics and Phase Transformations
MSE 175	Design Failure Investigation
MSE 189A- 189B- 189C	Senior Design Project I and Senior Design Project II and Senior Design Project III
MSE 190	Materials Selection and Design
EECS 70A or ENGRMAE 60	Network Analysis I Electric Circuits
ENGR 54	Principles of Materials Science and Engineering
ENGR 150 or ENGRMAE 150	Mechanics of Structures Mechanics of Structures
ENGRMAE 10	Introduction to Engineering Computations
ENGRMAE 30 or ENGR 30 or ENGRCEE 30	Statics Statics Statics
ENGRMAE 150L	Mechanics of Structures Laboratory
Engineering Electives:	
Students must complete a minimum of four courses from the lists below (at most two of the courses can be Basic Science or Engineering Electives, and at least two courses must be Technical Electives):	
Basic Science or Engineering Electives	
BIO SCI 93	From DNA to Organisms
BME 50A	Cell and Molecular Engineering
BME 50B	Cell and Molecular Engineering
EECS 70B	Network Analysis II
ENGR 7A- 7B	Introduction to Engineering I and Introduction to Engineering II
ENGRMAE 52	Computer-Aided Design
ENGRMAE 80 or ENGRCEE 80 or ENGR 80	Dynamics Dynamics Dynamics
PHYSICS 52A	Fundamentals of Experimental Physics
STATS 7	Basic Statistics
Technical Electives	
BME 110B	Biomechanics II
BME 111	Design of Biomaterials

BME 120	Sensory Motor Systems
CBE 187	Semiconductor Device Packaging
EECS 170A	Electronics I
EECS 174	Semiconductor Devices
EECS 176	Fundamentals of Solid-State Electronics and Materials
ENGR 165	Advanced Manufacturing
ENGRMAE 114	Fuel Cell Fundamentals and Technology
ENGRMAE 117	Solar and Renewable Energy Systems
ENGRMAE 118	Sustainable Energy Systems
ENGRMAE 145	Theory of Machines and Mechanisms
ENGRMAE 147	Vibrations
ENGRMAE 151	Mechanical Engineering Design
ENGRMAE 153	Advanced BIOMEMS Manufacturing Techniques
ENGRMAE 155	Composite Materials and Structures
ENGRMAE 157	Lightweight Structures
MSE 141	Nano-Scale Materials and Applications
MSE 171	Green Engineering: Theory and Practice
MSE 173	Fundamentals of Materials Processing: How are Materials Processed to Make Things?
MSE 174	Composite Materials Design
MSE 176	Surface and Adhesion Science
MSE 199	Individual Study

Students select, with the approval of a faculty advisor, any additional engineering topics courses needed to satisfy school and department requirements.

Engineering Professional Topics Course:

ENGR 190W	Communications in the Professional World
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(The nominal Materials Science and Engineering program will require 187 units of courses to satisfy all university and major requirements. Because each student comes to UCI with a different level of preparation, the actual number of units will vary. Dual engineering majors are reminded that they are required to satisfy all requirements of both majors individually. Students should not assume that courses for one, such as senior design, will satisfy the requirements of the other, without prior approval.)

- ¹ ENGR 7A-ENGR 7B is available only to lower-division students. Both ENGR 7A-ENGR 7B must be taken to be counted as an Engineering Elective course.
- ² May be used to satisfy a maximum of one elective course requirement.

Students majoring in MSE may elect, with approval of their faculty advisor, to use available engineering electives to complete one of the following specializations.

Specialization in Materials Processing

Requires a minimum of three courses from:

CBE 187	Semiconductor Device Packaging
ENGR 165	Advanced Manufacturing
ENGRMAE 153	Advanced BIOMEMS Manufacturing Techniques
MSE 171	Green Engineering: Theory and Practice
MSE 173	Fundamentals of Materials Processing: How are Materials Processed to Make Things?
MSE 174	Composite Materials Design

Specialization in Energy Materials and Sustainability

Requires a minimum of three courses from:

ENGRMAE 114	Fuel Cell Fundamentals and Technology
ENGRMAE 117	Solar and Renewable Energy Systems
ENGRMAE 118	Sustainable Energy Systems

MSE 141	Nano-Scale Materials and Applications
MSE 171	Green Engineering: Theory and Practice

Specialization in Biomaterials:

Requires a minimum of three courses from:

BME 110B	Biomechanics II
BME 111	Design of Biomaterials
BME 120	Sensory Motor Systems
ENGRMAE 153	Advanced BIOMEMS Manufacturing Techniques

Specialization in Electronic and Functional Materials:

Requires a minimum of three courses from:

CBE 187	Semiconductor Device Packaging
EECS 170A	Electronics I
EECS 174	Semiconductor Devices
EECS 176	Fundamentals of Solid-State Electronics and Materials
MSE 141	Nano-Scale Materials and Applications
MSE 176	Surface and Adhesion Science

Specialization in Structural and Mechanical Materials:

Requires a minimum of three courses from:

ENGR 165	Advanced Manufacturing
MSE 173	Fundamentals of Materials Processing: How are Materials Processed to Make Things?
MSE 174	Composite Materials Design
ENGRMAE 145	Theory of Machines and Mechanisms
ENGRMAE 147	Vibrations
ENGRMAE 155	Composite Materials and Structures
ENGRMAE 157	Lightweight Structures

A sample program of study chart for the major in Materials Science and Engineering is available in the Undergraduate Student Affairs Office. Students should keep in mind that this program is based upon a sequence of prerequisites, beginning with adequate preparation in high school mathematics, physics, and chemistry. Students who are not adequately prepared, or who wish to make changes in the sequence for other reasons, must have their program approved by their faculty advisor. Materials Science and Engineering majors are encouraged to consult with academic counselors as needed, and students who are academically at risk are mandated to see a counselor as frequently as deemed necessary by the advising staff.

Sample Program of Study — Materials Science and Engineering

Freshman		
Fall	Winter	Spring
MATH 2A	MATH 2B	MATH 2D
ENGR 1A	CHEM 1B	CHEM 1C
ENGRMAE 10	PHYSICS 7C	CHEM 1LC
General Education	PHYSICS 7LC	PHYSICS 7D
	General Education	PHYSICS 7LD
Sophomore		
Fall	Winter	Spring
MATH 3A	MATH 3D	MATH 2E
PHYSICS 7E	MSE 60	EECS 70A
ENGR 30	Engineering Elective	MSE 69
ENGR 54	General Education	Engineering Elective
Junior		
Fall	Winter	Spring
MSE 165A	MSE 165B	MSE 165C
ENGR 150	MSE 155	MSE 165CL
ENGRMAE 150L	MSE 155L	MSE 190
MSE 164	ENGR 190W	General Education
MSE 164L	General Education	General Education
Senior		
Fall	Winter	Spring
MSE 151	MSE 175	MSE 189C

MSE 189A
MSE 158
Engineering Elective

MSE 189B
Engineering Elective
General Education

General Education
General Education