

# MATERIALS SCIENCE & ENGINEERING, BACHELOR OF SCIENCE

College of Engineering

## Materials Science & Engineering Undergraduate Program

The Materials Science and Engineering (BS) program is accredited by the Engineering Accreditation Commission of ABET (<http://www.abet.org>) under the commission's General Criteria and Program Criteria for Materials, Metallurgical, Ceramics, and Similarly Named Engineering Programs.

Materials science and engineering is directed toward an understanding of the structure, properties, and processing of materials. Society demands new and improved materials with capabilities far superior to common metals, polymers, and ceramics. New materials are needed for high-speed transportation systems, surgical and dental implants, new generations of power plants, renewable energy sources, and solid-state electronic and photonics devices in computer and communication technology. Both the development of new materials and the understanding of present-day materials demand a thorough knowledge of basic engineering and scientific principles, including crystal structure, elastic and plastic behavior, thermodynamics, phase equilibria and reaction rates, and structural and physical and chemical behavior of engineering materials.

Materials engineers study phenomena found in many different engineering operations, from fracture behavior in automobiles to fatigue behavior in aircraft frames, from corrosion behavior in petro-chemical refineries to radiation-induced damage in nuclear power plants, and from the fabrication of steel to the design of semiconductors. Materials engineers are also increasingly involved in developing the new materials needed to attain higher efficiencies in existing and proposed energy conversion schemes and will play a central role in the development of new technologies based on composites and high-temperature superconductivity.

The undergraduate materials science and engineering program provides the background for activities in research, processing, and the design of materials. The curriculum is based on a common core of courses basic to engineering; courses taken during your first two years provide a strong foundation in fundamental engineering concepts.

## Objectives

We educate students in the fundamentals of materials science and engineering, balanced with the application of these principles to practical problems; educate students as independent, critical thinkers who can also function effectively in a team; educate students with a sense of community, ethical responsibility, and professionalism; educate students for careers in industry, government, and academia; teach students the necessity for continuing education and self-learning; and foster proficiency in written and oral communications.

Students are encouraged to adhere carefully to all prerequisite requirements. The instructor is authorized to drop students from a course for which stated prerequisites have not been completed.

## Honors Program

An Honors Program is available to qualified students in Materials Science & Engineering. It is a two-year program designed to challenge the most talented students in these majors. Students are invited to participate in their sophomore year. In the upper division coursework, students will complete either an honors thesis or a project that might involve local industry. Students must maintain a grade point average of 3.500 to continue in the program. Successful completion of the Honors Program will be acknowledged on the student's transcript.

The major requirements below are in addition to meeting University Degree Requirements (<https://catalog.ucdavis.edu/undergraduate-education/university-degree-requirements/>) & College Degree Requirements (<https://catalog.ucdavis.edu/undergraduate-education/college-degree-requirements/>); unless otherwise noted. The minimum number of units required for the Materials Science & Engineering Bachelor of Science is 157.

Code	Title	Units
<b>Lower Division Required Courses</b>		
<i>Mathematics</i>		
MAT 021A	Calculus	4
MAT 021B	Calculus	4
MAT 021C	Calculus	4
MAT 021D	Vector Analysis	4
MAT 022A	Linear Algebra	3
MAT 022B	Differential Equations	3
<i>Physics</i>		
PHY 009A	Classical Physics	5
PHY 009B	Classical Physics	5
PHY 009C	Classical Physics	5
PHY 009D	Modern Physics	4
<i>Chemistry</i>		
CHE 002A	General Chemistry	5
or CHE 002AH	Honors General Chemistry	
CHE 002B	General Chemistry	5
or CHE 002BH	Honors General Chemistry	
CHE 002C	General Chemistry	5
or CHE 002CH	Honors General Chemistry	
<i>Engineering</i>		
ENG 003	Introduction to Engineering Design	4
or ENG 003Y	Introduction to Engineering Design	
Choose one:		4
ENG 017	Circuits I	
or ENG 017V	Circuits I	
ENG 035	Statics	
ENG 045	Properties of Materials	4
or ENG 045Y	Properties of Materials	
<i>Materials Science Engineering</i>		
EMS 002	Materials Marvels: The Science of Superheroes	3
<i>Programming</i>		
ECH 060	Chemical Engineering Problem Solving	4
or ECS 032A	Introduction to Programming	
or ECS 032AV	Introduction to Programming	

Lower Division Composition/Writing; choose one: a grade of C- or better is required:		4
COM 001	Major Works of the Ancient World	
COM 002	Major Works of the Medieval & Early Modern World	
COM 003	Major Works of the Modern World	
COM 004	Major Works of the Contemporary World	
ENL 003	Introduction to Literature	
or ENL 003V	Introduction to Literature	
NAS 005	Introduction to Native American Literature	
UWP 001	Introduction to Academic Literacies (Recommended)	
or UWP 001Y	Introduction to Academic Literacies	
or UWP 001V	Introduction to Academic Literacies: Online	
Lower Division Required Courses Subtotal		79
<b>Upper Division Required Courses</b>		
<i>Engineering</i>		
ENG 190	Professional Responsibilities of Engineers	3
<i>Materials Science Engineering</i>		
EMS 160	Thermodynamics of Materials	4
EMS 162	Structure & Characterization of Engineering Materials	4
EMS 162L	Structure & Characterization of Materials Laboratory	3
EMS 164	Kinetics of Materials	4
EMS 170	Sustainable Energy Technologies: Batteries, Fuel Cells, & Photovoltaic Cells	4
EMS 170L	Sustainable Energy Technologies Laboratory	3
EMS 172	Smart Materials	4
EMS 172L	Smart Materials Laboratory	3
EMS 174	Mechanical Behavior of Materials	4
EMS 174L	Mechanical Behavior Laboratory	3
EMS 180	Materials in Engineering Design	4
EMS 182	Failure Analysis	4
EMS 181	Manufacturing of 3D & Composite Materials	4
or EMS 183	Processing of 2D & Nanomaterials	
EMS 186A	Materials Design Project	2
EMS 186B	Materials Design Project	3
EMS 186C	Materials Design Project	3
Choose one:		4
ECH 140	Mathematical Methods in Biochemical & Chemical Engineering	
ECI 114	Probabilistic Systems Analysis for Civil & Environmental Engineers	
EME 115	Introduction to Numerical Analysis & Methods	
ENG 180	Engineering Analysis	
MAT/BIS 107	Probability & Stochastic Processes with Applications to Biology	
MAT 118A	Partial Differential Equations: Elementary Methods	
MAT 128A	Numerical Analysis	

MAT 128B	Numerical Analysis in Solution of Equations	
MAT 128C	Numerical Analysis in Differential Equations	
MAT 135A	Probability	
MAT 167	Applied Linear Algebra	
MAT 168	Optimization	
PHY 104A	Introduction to Mathematical Methods in Physics	
STA 131A	Introduction to Probability Theory	
Choose one:		3-4
CHE 110A	Physical Chemistry: Introduction to Quantum Mechanics	
CHE 124A	Inorganic Chemistry: Fundamentals	
CHE 128A	Organic Chemistry	
PHY 108 & 108L	Optics and Optics Laboratory	
PHY 110A	Electricity & Magnetism	
PHY 122A	Advanced Laboratory in Condensed Matter Physics	
PHY 151	Stellar Structure & Evolution	
PHY/ENG 160	Environmental Physics & Society	

*Focused Electives*

Courses used to satisfy degree requirements are not eligible to be used to satisfy the elective requirement. 12

Students may elect to choose up to 5 units from the following lower division courses:

BIM 020	Fundamentals of Bioengineering	
BIS 002A	Introduction to Biology: Essentials of Life on Earth	
EBS 075	Properties of Materials in Biological Systems	
ENG 017	Circuits I	
or ENG 017V	Circuits I	
ENG 035	Statics	

Remaining units must be satisfied by the following:

BIM 106	Biotransport Phenomena	
BIM 109	Biomaterials	
ECI 130	Structural Analysis	
ECI 132	Structural Design: Metallic Elements	
EEC 140A	Principles of Device Physics I	
or EEC 140AV	Principles of Device Physics I	
EEC 140B	Principles of Device Physics II	
EEC 146A	Integrated Circuits Fabrication	
ENG 100	Electronic Circuits & Systems	
ENG 102	Dynamics	
ENG 103	Fluid Mechanics	
ENG 104	Mechanics of Materials	
or ENG 104V	Mechanics of Materials	

**OR**

Any upper division courses in Materials Science & Engineering (EMS); a maximum of 4 units combined in Materials Science & Engineering (EMS) courses numbered 190-197 or 199 can be used to satisfy focused electives requirement.

Choose one; grade of C- or better is required: 0-4

UWP 102E	Writing in the Disciplines: Engineering
UWP 102F	Writing in the Disciplines: Food Science & Technology
UWP 104A	Writing in the Professions: Business Writing
or UWP 104AV	Writing in the Professions: Business Writing
or UWP 104AY	Writing in the Professions: Business Writing
UWP 104E	Writing in the Professions: Science
UWP 104T	Writing in the Professions: Technical Writing

Passing the Upper Division Composition Exam.

Upper Division Required Courses Subtotal	78-83
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<b>Total Units</b>	<b>157-162</b>
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