

## Required Courses for Materials Science & Engineering Degree – 2019-20

This program is accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>

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To make an advising appointment, please visit: [appointments.ucdavis.edu](http://appointments.ucdavis.edu)

*Note: Curriculum and course offerings are subject to change. You must fulfill the degree requirements stated in the catalog of the year you graduate or the year immediately prior. For additional detail on degree requirements and coursework, please visit: <https://ucdavis.pubs.curricUNET.com/Catalog/ems>*

### English Composition Requirements

#### Lower Division English Composition (4 units)

Select **ONE** of the following courses:

UWP 1, 1V, or 1Y	Expository Writing
ENL 3	Introduction to Literature
COM 1	Bks of West Civ /Ancient World
COM 2	Bks of West Civ/MidAge-Enligh.
COM 3	Bks of West Civ/Modern Crisis
COM 4	Bks of Contemporary World
NAS 5	Intro to Native American Lit.

*Course must be completed with a C- or better. A 4 or 5 on your AP English exam will also satisfy this requirement.*

#### Upper Division English Composition (0 or 4 units)

Select **ONE** of the following courses:

UWP 102E or 102F	Writing in the Disciplines
UWP 104A, 104E, or 104T	Writing in the Professions

*Course must be completed with a C- or better. This requirement can also be satisfied by passing the [Upper Division Composition Exam](#).*

### General Education Requirement

This requirement is partially satisfied with coursework completed for the MSE degree. A detailed GE checklist can be found [here](#).

### Lower Division Major Requirements

#### Math, Physics, and Chemistry (56 units)

Course Number	Course Title	Units	Qtr Offered			Prerequisites
MAT 21A	Calculus	4	F	W	S	Two years of high school algebra, plane geometry, plane trigonometry, and analytical geometry, and satisfying the Mathematics Placement Requirement
MAT 21B	Calculus	4	F	W	S	C- or better in MAT 21A or 21AH
MAT 21C	Calculus	4	F	W	S	C- or better in MAT 21B or 21BH
MAT 21D	Vector Analysis	4	F	W	S	C- or better in MAT 21C or 21CH
MAT 22A	Linear Algebra	3	F	W	S	C- or better in MAT 21C; ENG 6, EME 5, ECH 60, or MAT 22AL (can be concurrent)
MAT 22B	Differential Equations	3	F	W	S	C- or better in MAT 22A or MAT 67
PHY 9A	Classical Physics	5	F		S	MAT 21B
PHY 9B	Classical Physics	5	F	W		PHY 9A, MAT 21C, MAT 21D☺
PHY 9C	Classical Physics	5		W	S	PHY 9B, MAT 21D, MAT 22A☺
PHY 9D	Classical Physics	4	F		S	PHY 9C, MAT 22A, MAT 22B recommended ☺
CHE 2A	General Chemistry	5	F	W		<a href="#">Multiple pathways</a>
CHE 2B	General Chemistry	5		W	S	C- or better in CHE 2A or 2AH
CHE 2C	General Chemistry	5	F		S	C- or better in CHE 2B or 2BH

#### Lower Division Engineering (19 units)

Course Number	Course Title	Units	Qtr Offered			Prerequisites
EMS 2	Materials Marvels	3		W		None
ENG 3	Introduction to Engineering Design	4	F	W	S	Completion of Entry Level Writing Requirement (ELWR)
ECH 60	Computational Methods	4			S	MAT 21C
ENG 45 or ENG 45Y	Properties of Materials	4 4	F	W	S SS	C- or better in all of the following: MAT 21C, CHE 2A & PHY 9A ENG 45Y is a hybrid course only offered in Summer Session (same prerequisites as ENG 45)

Choose **ONE** of the following:

ENG 17	Circuits	4	F	W	S	MAT 21C (C- or better recommended)
ENG 35	Statics	4	F	W	S	C- or better in PHY 9A or PHY 9HA; C- or better in MAT 21D ☺

## Upper Division Major Requirements

### Engineering (3 units)

Course Number	Course Title	Units	Qtr Offered	Prerequisites
ENG 190	Professional Responsibilities of Engineers ( <i>SS GE3 credit</i> )	3	W S	Upper division standing in the College of Engineering

### Materials Science Fundamentals (20 units)

Course Number	Course Title	Units	Qtr Offered	Prerequisites
EMS 160	Thermodynamics of Materials	4	F	C- or better in each of the following: ENG 45, PHY 9B, MAT 22B; CHE 2C recommended
EMS 162	Structure & Characterization of Engineering Materials	4	W	C- or better in each of the following: ENG 45, MAT 22A, PHY 9B
EMS 164	Kinetics of Materials	4	W	C- or better in ENG 45; EMS 160
EMS 172	Smart Materials	4	F	CHE 110A or PHY 9D; ENG 6 or ECH 60 or equivalent (recommended)
EMS 174	Mechanical Behavior of Materials	4	S	C- or better in ENG 45; EMS 162 (recommended)

### Materials Science Laboratory (12 units)

Course Number	Course Title	Units	Qtr Offered	Prerequisites
EMS 162L	Structure & Characterization of Engineering Materials Lab	3	W	EMS 162 ☺ (concurrent enrollment recommended)
EMS 170L	Sustainable Energy Technologies Laboratory	3	S	ENG 45, EMS 170 ☺, EMS 172 (recommended)
EMS 172L	Smart Materials Laboratory	3	F	EMS 172 ☺ (concurrent enrollment recommended)
EMS 174L	Mechanical Behavior Lab	3	S	EMS 174 ☺ (concurrent enrollment recommended)

### Engineering Application of Materials (20 units)

Course Number	Course Title	Units	Qtr Offered	Prerequisites
EMS 170	Sustainable Energy Technologies: Batteries, Fuel Cells, and Photovoltaic Cells	4	S	ENG 45 or ENG 45Y. Open to students in Engineering or related fields.
EMS 180	Materials in Engineering Design	4	F	C- or better in ENG 45, upper division standing
EMS 182	Failure Analysis	4	F	C- or better in ENG 45 or ENG 45Y; EMS 174 recommended
EMS 188A	Materials Design Project	4	W	EMS 160, 162, 164, 172, and 174
EMS 188B	Materials Design Project	4	S	EMS 188A

### Processing of Materials (4 units)

Choose **ONE** of the following:

EMS 181	Manufacturing of 3D & Composite Materials	4	W	C- or better in ENG 45 or ENG 45Y; ENG 105 or ECH 152B or EEC 140A or EMS 164
EMS 183	Processing of 2D & Nanomaterials	4	W	C- or better in ENG 45 or ENG 45Y; ENG 105 or ECH 152B or EEC 140A or EMS 164

### Applied Mathematics Elective (4 units) Choose one of the following courses.

Course Number	Course Title	Units	Qtr Offered	Prerequisites
ECH 140	Mathematical Methods	4	F	MAT 22B; ECH 60 or equivalent
ECI 114	Probabilistic Systems Analysis for Civil Engineers	4	W S	C- or better in MAT 21C
EME 115	Introduction to Numerical Analysis and Methods	4	F	C- or better in ENG 6, EME 5, ECS 30, or ECM 6; C- or better in MAT 21A, 21B, 21C, 21D, 22A, 22B; C- or better in PHY 9A, 9B or 9C
ENG 180	Engineering Analysis	4	F	C- or better in ENG 6, EME 5, or ECS 30; C- or better in MAT 21D and MAT 22B
MAT 135A	Probability	4	F W	MAT 21C; MAT 108 or 25
PHY 104A	Mathematical Physics	4	F	C- or better in PHY 9B, 9C, and 9D; C- or better in MAT 21D, 22A, and 22B; or ☞
STA 131A	Intro. To Probability Theory	4	F S	MAT 21B; MAT 21C; MAT 22A or 67

### Basic Science Elective (3-4 units)

Choose **ONE** of the following courses.

Course Number	Course Title	Units	Qtr Offered	Prerequisites
CHE 110A	Physical Chemistry: Intro. to Quantum Mech.	4	F S	PHY 9C, CHE 2C, MAT 21C; Completion of MAT 21D, 22A, 22AL, and PHY 9C strongly recommended.
CHE 124A	Inorganic Chemistry: Fundamentals	3	F W S	CHE 2C
CHE 128A	Organic Chemistry	3	F W	C or better in CHE 2C
PHY 108/108L	Optics/Optics Lab	4	S	PHY 9A, 9B, 9C, 9D, MAT 21A, B, C, D; or ☞
PHY 110A	Electricity and Magnetism	4	W	C- or better in PHY 9B, 9C, 9D, MAT 21D, 22A, and 22B; PHY 104A; PHY 105A; or consent of department
PHY 122A	Advanced Condensed Matter Lab	4	W S	PHY 104A, 105A, 110B, 115A and 112 ☺; or consent of department
PHY 151*	Stellar Structure & Evolution	4	F	PHY 9A, 9B, 9C, 9D or ☞
PHY 160*	Environmental Physics and Society	3	S	PHY 9D or 7C; or PHY 10 or 1B and MAT 16B; or equivalent

**Focused Electives (12 units)**

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

Any upper division courses in Materials Science & Engineering (EMS) and a maximum of 4 units in Materials Science & Engineering (EMS) 199 units can be used to satisfy the focused electives requirement.

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

Course Number	Course Title	Units	Qtr Offered			Prerequisites
BIS 2A	Introduction to Biology: Essentials of Life on Earth	5	F	W	S	None
EBS 75	Properties of Materials in Biological Systems	4		W		BIS 2A; PHY 9C ☺
BIM 20	Fundamentals of Bioengineering	4			S	C- or better in CHE 2B and MAT 21D; PHY 9B
ENG 17	Circuits	4	F	W	S	MAT 21C (C- or better recommended)
ENG 35	Statics	4	F	W	S	C- or better in PHY 9A, MAT 21D ☺

Remaining units must be satisfied by the following:

Course Number	Course Title	Units	Qtr Offered			Prerequisites
BIM 106	Biotransport Phenomena	4		W		C- or better in BIM 20; BIM 116 or NPB 101; PHY 9B; MAT 22B; Open to BIM majors
BIM 109	Biomaterials	4			S	BIS 2A, CHE 2C, BIM 106, upper division standing Engineering majors
ECI 130	Structural Analysis	4	F		S	C- or better in ENG 104; MAT 22A; Open to ECI majors
ECI 132	Structural Design: Metallic Elements	4	F			ECI 130
EEC 140A	Principles of Device Physics I	4	F	W		ENG 17 ☺, PHY 9D
EEC 140B	Principles of Device Physics II	4			S	EEC 140A
EEC 146A	Integrated Circuits Fabrication	4	F			EEC 140A
ENG 100	Electronic Circuits and Systems	3	F	W	S	C- or better recommended in ENG 17
ENG 102	Dynamics	4	F	W	S	C- or better in ENG 35, MAT 22B, PHY 9B
ENG 103	Fluid Mechanics	4	F	W	S	C- or better in ENG 35, MAT 22B, PHY 9B
ENG 104	Mechanics of Materials	4	F	W	S	C- or better in ENG 35 and MAT 22B

Other upper division courses in engineering or science will be considered on an individual basis by submitting a [Request for a Course Substitution](#) AND consulting with your major advisor.

☺ May be taken concurrently 📖 May be taken with consent of instructor \*Course not regularly offered

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