

# Energy Engineering

## Bachelor of Science (BS)

The Energy Engineering major offered through the Engineering Science Program interweaves the fundamentals of classical and modern physics, chemistry, and mathematics with energy engineering applications. A great strength of the major is its flexibility. The firm base in physics and mathematics is augmented with a selection of engineering course options that prepare the student to tackle the complex energy-related problems faced by society. Because the program emphasizes science and mathematics, students are well-prepared to pursue graduate studies in physics or engineering. Energy engineering is a multidisciplinary field requiring the integration of physical principles with engineering analysis, augmented with the realities of policy and engineering economics. The program incorporates courses from many departments on campus to create a discipline that is rigorously based in science, mathematics, and engineering while addressing a wide variety of environmental issues.

## Admission to the Major

Prospective undergraduates in the College of Engineering must apply for admission to one specific major/degree program. For further information, please see the College of Engineering's website (<http://coe.berkeley.edu/students/prospective-students/admissions.html>).

Admission to engineering via a Change of College application for current UC Berkeley students is very competitive, as there are few open spaces in engineering for students admitted to other colleges at UC Berkeley. For further information regarding a Change of College to Engineering, please see the college's website (<http://coe.berkeley.edu/students/current-undergraduates/change-of-college/>).

## Minor Program

The Energy Engineering minor has arisen as a natural outgrowth of the large amount of energy-related research in the College of Engineering. For a number of years, courses have been developed across the College of Engineering, and the energy engineering minor is designed to coordinate these courses for students who have an interest in systems that are associated with all aspects of energy systems, such as generation, transmission, and consumption. The energy minor, offered through the College of Engineering, is an optional program that encourages coherence in the work students undertake around energy engineering.

For admission to the minor, students must have a minimum overall grade point average (GPA) of 3.0 and have also completed all of the prerequisite courses. For information regarding the prerequisites, please see the Minor Requirements tab on this page.

After completion of the prerequisite courses, students will need to complete and submit a Petition for Admission form (<http://engineeringsscience.berkeley.edu/wp-content/uploads/2013/09/Energy-Minor-Application-2103-141.pdf>) to the undergraduate staff adviser. Students must apply at least one semester prior to graduation (i.e., students cannot be on the official degree list at the time of application). Students will also need to submit a copy of their transcript and a course plan at the time of application.

Upon completion of the minor requirements, submit a Petition for Completion of the Undergraduate Minor (<http://engineeringsscience.berkeley.edu/wp-content/uploads/2013/09/energy->

[minor-confirm-completion-of-Minor-2013-141.pdf](#)) to the undergraduate staff adviser. This must be completed no later than two weeks prior to the end of the semester.

## Other Majors offered by the Engineering Science Program

Engineering Mathematics and Statistics (<http://guide.berkeley.edu/undergraduate/degree-programs/engineering-math-statistics/>)  
 Engineering Physics (<http://guide.berkeley.edu/undergraduate/degree-programs/engineering-physics/>)  
 Environmental Engineering Science (<http://guide.berkeley.edu/undergraduate/degree-programs/environmental-engineering-science/>)

In addition to the University, campus, and college requirements, students must fulfill the below requirements specific to their major program.

## General Guidelines

1. All technical courses taken in satisfaction of major requirements must be taken for a letter grade.
2. No more than one upper division course may be used to simultaneously fulfill requirements for a student's major and minor programs.
3. A minimum overall grade point average (GPA) of 2.0 is required for all work undertaken at UC Berkeley.
4. A minimum GPA of 2.0 is required for all technical courses taken in satisfaction of major requirements.

For information regarding residence requirements and unit requirements, please see the College Requirements tab.

For a detailed plan of study by year and semester, please see the Plan of Study tab.

## Lower Division Requirements

MATH 1A	Calculus	4
MATH 1B	Calculus	4
MATH 53	Multivariable Calculus	4
MATH 54	Linear Algebra and Differential Equations	4
PHYSICS 7A	Physics for Scientists and Engineers	4
PHYSICS 7B	Physics for Scientists and Engineers	4
CHEM 1A & 1AL	General Chemistry and General Chemistry Laboratory	5
or CHEM 4A	General Chemistry and Quantitative Analysis	
ENGIN 7	Introduction to Computer Programming for Scientists and Engineers	4
or COMPSCI 6	The Structure and Interpretation of Computer Programs	
ENGIN 93	Energy Engineering Seminar	1
MEC ENG 40	Thermodynamics	3-4
or ENGIN 40	Engineering Thermodynamics	
Select two Engineering Prep courses: <sup>2</sup>		6-10
CHEM 1B	General Chemistry [4]	
CHEM 3A	Chemical Structure and Reactivity [3]	
CIV ENG 11	Engineered Systems and Sustainability [3]	
CIV ENG 70	Engineering Geology [3]	

COMPSCI C8	Foundations of Data Science [4] (must also take connector course: course number 88)
COMPSCI 61B	Data Structures [4]
EECS 16A	Designing Information Devices and Systems I [4]
EECS 16B	Designing Information Devices and Systems II [4]
MAT SCI 45 & 45L	Properties of Materials and Properties of Materials Laboratory
MEC ENG C85/ CIV ENG C30	Introduction to Solid Mechanics [3]
MEC ENG 104	Engineering Mechanics II [3]
PHYSICS 7C	Physics for Scientists and Engineers [4]

<sup>1</sup> CHEM 4A is intended for students majoring in chemistry or a closely-related field.

<sup>2</sup> Students interested in the areas of data, distribution, generation or materials are advised to choose the following courses for Engineering Prep:

- Data: COMPSCI C8 + connector (course number 88) and COMPSCI 61B
- Distribution: EECS 16A and EECS 16B
- Generation: MEC ENG C85 and MEC ENG 104
- Materials: MAT SCI 45 + MAT SCI 45L and PHYSICS 7C

## Upper Division Requirements

Due to the interdisciplinary nature of this major, electives may be approved throughout the year.

CIV ENG 100	Elementary Fluid Mechanics or MEC ENG 100 Fluid Mechanics	3-4
CIV ENG 186	Design of Internet-of-Things for Smart Cities	3
EL ENG 134	Fundamentals of Photovoltaic Devices	4
EL ENG 137A	Introduction to Electric Power Systems	4
EL ENG 137B	Introduction to Electric Power Systems or EL ENG 113 Power Electronics	4
ENE,RES C100	Energy and Society	4
ENGIN 194	Undergraduate Research <sup>6</sup>	3
MEC ENG 109	Heat Transfer	3
Sustainability Course, select one course from the following: <sup>2</sup>		3-4
CIV ENG 110	Water Systems of the Future [3]	
CIV ENG 111	Environmental Engineering [3]	
CIV ENG 113	Ecological Engineering for Water Quality Improvement [3]	
CIV ENG 115	Water Chemistry [3]	
CY PLAN 119	Planning for Sustainability [4]	
Economics Course: Choose one from the following <sup>3</sup>		3-4
ENE,RES 101	Ecology and Society [3]	
ENE,RES 180	Ecological Economics in Historical Context [3]	
ENVECON 147	The Economics of the Clean Energy Transition [4]	
ENVECON C150	Development Economics [4]	
ENVECON 153	Population, Environment, and Development [3]	
ENVECON 154	Economics of Poverty and Technology [3]	
ESPM 102D	Climate and Energy Policy [4]	
IND ENG 120	Principles of Engineering Economics [3]	

POLECON 101 Contemporary Theories of Political Economy [4]  
or an economics course chosen in consultation with faculty adviser.

Math/Statistics/Analysis Course: Choose from list below or choose CIV ENG 191 or EECS 127 <sup>4</sup> 3-4

CIV ENG 93 Engineering Data Analysis [3]

COMPSCI 70 Discrete Mathematics and Probability Theory [4]

ENGIN 117 Methods of Engineering Analysis [3]

IND ENG 172 Probability and Risk Analysis for Engineers [4]

MATH 55 Discrete Mathematics [4]

STAT 134 Concepts of Probability [4]

Engineering Electives <sup>5</sup> 12

<sup>1</sup> ENE,RES C100 satisfies both a major requirement and one of the upper division humanities/social sciences requirements. It must be taken for a letter grade.

<sup>2</sup> CY PLAN 119 may also fulfill one of the upper division humanities/social sciences requirements. This requirement must be taken for a letter grade.

<sup>3</sup> Some of these courses can satisfy both the economics requirement and one of the upper division humanities/social sciences requirements. This requirement must be taken for a letter grade.

<sup>4</sup> Students interested in data are advised to take CIV ENG 191, IND ENG 172 or STAT 134 for the Math/Statistics/Analysis requirement.

<sup>5</sup> Students are required to take four engineering electives of at least 3 units each. Engineering electives include upper division courses in any engineering department and must be chosen in consultation with a faculty adviser. The only course not offered by an engineering department that can count toward this requirement is ENE,RES 131. Courses used to satisfy other major requirements cannot also fulfill the engineering elective requirement. Engineering electives cannot include any courses taken on a P/NP basis; BIOENG 100; DESINV courses (except DES INV 190E); ENGIN 125, 157AC, 180, 183 series, 185, 187, 195 series; INDENG 172, 185, 186, 190 series, 191, 192, 195; MECENG 190K, 191AC, 191K. Students interested in data, distribution, generation, or materials are advised to choose from the following courses as their engineering electives:

- Data: COMPSCI 180 series courses, STAT 133, STAT 135 (exception approved for these two Statistics courses)
- Distribution: COMPSCI 61B (exception approved for this lower division course), EL ENG 105, EL ENG 113, EL ENG 117, EL ENG 120, EL ENG C128/MEC ENG C134, MEC ENG 132
- Generation: BIO ENG C181, MEC ENG 130, MEC ENG 140, MEC ENG 146, NUC ENG 161
- Materials: MAT SCI 103, MAT SCI 111, MAT SCI 113, MAT SCI 125, MAT SCI 136

<sup>6</sup> Research capstone course: Original research with approved faculty member.

Minor programs are areas of concentration requiring fewer courses than an undergraduate major. These programs are optional but can provide depth and breadth to a UC Berkeley education. The College of Engineering does not offer additional time to complete a minor, but it is usually possible to finish within the allotted time with careful course planning. Students are encouraged to meet with their ESS adviser to discuss the feasibility of completing a minor program.

All the engineering departments offer minors. Students may also consider pursuing a minor in another School or College.

## General Guidelines

1. All minors must be declared no later than one semester before a student's Expected Graduation Term (EGT). If the semester before EGT is fall or spring, the deadline is the last day of RRR week. If the semester before EGT is summer, the deadline is the final Friday of Summer Sessions. To declare a minor, contact the department advisor for information on requirements, and the declaration process.
2. All courses taken to fulfill the minor requirements must be taken for graded credit.
3. A minimum overall grade point average (GPA) of 3.0 and a minimum GPA of 3.0 in the prerequisite courses is required for acceptance into the minor program.
4. A minimum grade point average (GPA) of 2.0 is required for courses used to fulfill the minor requirements.
5. No more than one upper division course may be used to simultaneously fulfill requirements for a student's major and minor programs.
6. Completion of the minor program cannot delay a student's graduation.

## Lower Division Prerequisites

MATH 1A	Calculus	4
MATH 1B	Calculus	4
MATH 53	Multivariable Calculus	4
MATH 54	Linear Algebra and Differential Equations	4

Select one of the following:

CHEM 1A & 1AL	General Chemistry and General Chemistry Laboratory	
CHEM 4A	General Chemistry and Quantitative Analysis [5]	
PHYSICS 7A	Physics for Scientists and Engineers	4
PHYSICS 7B	Physics for Scientists and Engineers	4
ENGIN 7	Introduction to Computer Programming for Scientists and Engineers	4

## Upper Division Minor Requirements

MEC ENG 40	Thermodynamics (or approved equivalent)	3
EL ENG 137A	Introduction to Electric Power Systems	4

Select one of the following: 4

ENE,RES C10	(Energy and Society [4])	
CIV ENG 111	Environmental Engineering [3]	
CIV ENG C106	Air Pollution	3

Select two of the following: 8

ARCH 140	Energy and Environment [4]	
CY PLAN 119	Planning for Sustainability [4]	
CIV ENG 107	Climate Change Mitigation [3]	
CIV ENG 111	Environmental Engineering [3]	
CIV ENG 115	Water Chemistry [3]	
EL ENG 134	Fundamentals of Photovoltaic Devices [4]	
EL ENG 137B	Introduction to Electric Power Systems [4]	

ENE,RES C100	Energy and Society [4]	
ENE,RES 101	Ecology and Society [3]	
ENGIN 120	Principles of Engineering Economics [3]	
ENGIN 194	Undergraduate Research [3]	
ENVECON 147	The Economics of the Clean Energy Transition [4]	
ENVECON C11	Development Economics [4]	
ENVECON 153	Population, Environment, and Development [3]	
ENVECON 154	Economics of Poverty and Technology [3]	
ESPM 102D	Climate and Energy Policy [4]	
GEOG 142	Global Climate Variability and Change [4]	
IND ENG 172	Probability and Risk Analysis for Engineers [4]	
	or STAT 134	Concepts of Probability
MAT SCI 136	Materials in Energy Technologies [4]	
MEC ENG 106	Fluid Mechanics [3]	
MEC ENG 109	Heat Transfer [3]	
NUC ENG 161	Nuclear Power Engineering [4]	
POLECON 101	Contemporary Theories of Political Economy [4]	

## Students in the College of Engineering must complete no fewer than 120 semester units with the following provisions:

1. Completion of the requirements of one engineering major program (<https://engineering.berkeley.edu/students/undergraduate-guide/degree-requirements/major-programs/>) of study.
2. A minimum overall grade point average of 2.00 (C average) and a minimum 2.00 grade point average in upper division technical coursework required of the major.
3. The final 30 units and two semesters must be completed in residence in the College of Engineering on the Berkeley campus.
4. All technical courses (math, science, and engineering) that can fulfill requirements for the student's major must be taken on a letter graded basis (unless they are only offered P/NP).
5. Entering freshmen are allowed a maximum of eight semesters to complete their degree requirements. Entering junior transfers are allowed five semesters to complete their degree requirements. Summer terms are optional and do not count toward the maximum. Students are responsible for planning and satisfactorily completing all graduation requirements within the maximum allowable semesters.
6. Adhere to all college policies and procedures (<https://engineering.berkeley.edu/students/undergraduate-guide/policies-procedures/>) as they complete degree requirements.
7. Complete lower division technical courses before enrolling in upper division technical courses.

## Humanities and Social Sciences (H/SS) Requirement

To promote a rich and varied educational experience outside of the technical requirements for each major, the College of Engineering has a six-course Humanities and Social Sciences breadth requirement (<http://engineering.berkeley.edu/student-services/degree-requirements/humanities-and-social-sciences/>), which must be completed to graduate. This requirement, built into all the engineering programs of study, includes two Reading and Composition courses (R&C), and four additional courses within which a number of specific conditions must be satisfied. See the humanities and social sciences (<https://engineering.berkeley.edu/students/undergraduate-guide/degree->

requirements/humanities-and-social-sciences/) section of our website for details.

## Class Schedule Requirements

- Minimum units per semester: 12.0
- Maximum units per semester: 20.5
- Minimum technical courses: College of Engineering undergraduates must include at least two letter graded technical courses (of at least 3 units each) in their semester program. Every semester students are expected to make satisfactory progress in their declared major. Satisfactory progress is determined by the student's Engineering Student Services Advisor. (Note: For most majors, normal progress (<https://engineering.berkeley.edu/academics/undergraduate-guide/policies-procedures/scholarship-progress/#ac12282>) will require enrolling in 3-4 technical courses required of your current major each semester.) Students who are not in compliance with this policy by the end of the fifth week of the semester are subject to a registration block that will delay enrollment for the following semester.
- All technical courses (math, science, engineering) that satisfy requirements for the major must be taken on a letter-graded basis (unless only offered as P/NP).

## Minimum Academic Requirements

- Students must have a minimum overall and semester grade point average of 2.00 (C average). Students will be subject to dismissal from the University if during any fall or spring semester their overall UC GPA falls below a 2.00, or their semester GPA is less than 2.00.
- Students must achieve a minimum grade point average of 2.00 (C average) in upper division technical courses required for the major curriculum each semester.
- A minimum overall grade point average of 2.00 and a minimum 2.00 grade point average in upper division technical course work required for the major are required to earn a Bachelor of Science in the College of Engineering.
- Students must make normal degree progress toward the Bachelor of Science degree and their officially declared major.

## Unit Requirements

To earn a Bachelor of Science in Engineering, students must complete at least 120 semester units of courses subject to certain guidelines:

- Completion of the requirements of one engineering major program (<https://engineering.berkeley.edu/students/undergraduate-guide/degree-requirements/major-programs/>) of study.
- A maximum of 16 units of special studies coursework (courses numbered 97, 98, 99, 197, 198, or 199) is allowed to count towards the B.S. degree, and no more than 4 units in any single term can be counted.
- A maximum of 4 units of physical education from any school attended will count towards the 120 units.
- Passed (P) grades may account for no more than one third of the total units completed at UC Berkeley, Fall Program for Freshmen (FPF), UC Education Abroad Program (UCEAP), or UC Berkeley Washington Program (UCDC) toward the 120 overall minimum unit requirement. Transfer credit is not factored into the limit. This includes transfer units from outside of the UC system, other UC campuses, credit-bearing exams, as well as UC Berkeley Extension XB units.

## Normal Progress

Students in the College of Engineering must enroll in a full-time program and make normal progress (<https://engineering.berkeley.edu/students/undergraduate-guide/policies-procedures/scholarship-progress/#ac12282>) each semester toward their declared major. Students who fail to achieve normal academic progress shall be subject to dismissal. (Note: Students with official accommodations established by the Disabled Students' Program, with health or family issues, or with other reasons deemed appropriate by the dean may petition for an exception to normal progress rules.)

## University of California Requirements

Entry Level Writing (<http://guide.berkeley.edu/undergraduate/education/#earningyourdegreertext>)

All students who will enter the University of California as freshmen must demonstrate their command of the English language by satisfying the Entry Level Writing Requirement (ELWR). The UC Entry Level Writing Requirement website (<https://admission.universityofcalifornia.edu/elwr/>) provides information on how to satisfy the requirement.

American History and American Institutions (<http://guide.berkeley.edu/undergraduate/education/#earningyourdegreertext>)

The American History and Institutions (AH&I) requirements are based on the principle that a US resident graduated from an American university should have an understanding of the history and governmental institutions of the United States.

## Campus Requirement

American Cultures (<http://guide.berkeley.edu/undergraduate/education/#earningyourdegreertext>)

The American Cultures requirement is a Berkeley campus requirement, one that all undergraduate students at Berkeley need to pass in order to graduate. You satisfy the requirement by passing, with a grade not lower than C- or P, an American Cultures course. You may take an American Cultures course any time during your undergraduate career at Berkeley. The requirement was instituted in 1991 to introduce students to the diverse cultures of the United States through a comparative framework. Courses are offered in more than fifty departments in many different disciplines at both the lower and upper division level.

For more detailed information regarding the courses listed below (e.g., elective information, GPA requirements, etc.), please see the College Requirements and Major Requirements tabs.

	Freshman	
	Fall Units	Spring Units
CHEM 4A or 1A <i>and</i> 1A1 <sup>1</sup>		5 MATH 1B 4
MATH 1A		4 PHYSICS 7A 4
ENGIN 93		1 ENGIN 7 or 4 COMPSCI 61A
Reading & Composition Part A Course <sup>4</sup>		4 Reading & 4 Composition Part B Course <sup>4</sup>
Humanities/Social Sciences course <sup>4</sup>		3-4
	<b>17-18</b>	<b>16</b>
	Sophomore	
	Fall Units	Spring Units
MATH 53		4 MATH 54 4

PHYSICS 7B	4 MEC ENG 40 or ENGIN 40	3-4
Engineering Prep course <sup>1</sup>	3-6 CIV ENG 100 or MEC ENG 106	3-4
ENE,RES C100 <sup>3</sup>	4 Engineering Prep course 2 <sup>2</sup>	3-4
<b>15-18</b>		<b>13-16</b>
<b>Junior</b>		
	<b>Fall Units</b>	<b>Spring Units</b>
EL ENG 137A	4 EL ENG 137B or 113	4
MEC ENG 109	3 Engineering Electives <sup>2</sup>	6-8
Economics Course <sup>2</sup>	3-4 Humanities/ Social Sciences course <sup>4</sup>	3-4
Engineering Elective <sup>2</sup>	3-4	
<b>13-15</b>		<b>13-16</b>
<b>Senior</b>		
	<b>Fall Units</b>	<b>Spring Units</b>
CIV ENG 186	3 ENGIN 194	3
Math/Statistics/Analysis Course or CIV ENG 191 or EL ENG 127 <sup>2</sup>	3-4 EL ENG 134	4
Engineering Elective <sup>2</sup>	3-4 Sustainability Course <sup>2</sup>	3
Humanities/Social Sciences course <sup>4</sup>	3-4 Humanities/ Social Sciences course <sup>4</sup>	3-4
Free Electives	4 Free Electives	4
<b>16-19</b>		<b>17-18</b>
<b>Total Units: 120-136</b>		

<sup>1</sup> CHEM 4A is intended for students majoring in chemistry or a closely-related field.

<sup>2</sup> See Major Requirements tab for approved courses.

<sup>3</sup> ENE,RES C100 satisfies both a major requirement and one of the upper division humanities/social sciences requirements. It must be taken for a letter grade.

<sup>4</sup> The Humanities/Social Sciences (H/SS) requirement includes two approved Reading & Composition (R&C) courses and four additional approved courses, with which a number of specific conditions must be satisfied. R&C courses must be taken for a letter grade (C- or better required). The first half (R&C Part A) must be completed by the end of the freshman year; the second half (R&C Part 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 [engineering.berkeley.edu/hss](https://engineering.berkeley.edu/hss) (<https://engineering.berkeley.edu/academics/undergraduate-guide/degree-requirements/humanities-and-social-sciences/>) for complete details and a list of approved courses.

Major Maps help undergraduate students discover academic, co-curricular, and discovery opportunities at UC Berkeley based on intended major or field of interest. Developed by the Division of Undergraduate Education in collaboration with academic departments, these experience maps will help you:

- **Explore** your major and gain a better understanding of your field of study

- **Connect** with people and programs that inspire and sustain your creativity, drive, curiosity and success

- **Discover** opportunities for independent inquiry, enterprise, and creative expression

- **Engage** locally and globally to broaden your perspectives and change the world

- **Reflect** on your academic career and prepare for life after Berkeley

Use the major map below as a guide to planning your undergraduate journey and designing your own unique Berkeley experience.

View the Energy Engineering Major Map PDF. ([https://ue.berkeley.edu/sites/default/files/engineering\\_science.pdf](https://ue.berkeley.edu/sites/default/files/engineering_science.pdf))