

Engineering Physics

Bachelor of Science (BS)

The engineering physics major offered through the Engineering Science Program interweaves classical and modern physics, chemistry, and mathematics with their engineering applications. Chief among the attractions of the major is its flexibility in that students have the ability to take diverse engineering, math, and science classes based on individual research goals. The solid base in physics and mathematics is augmented with a selection of engineering course options that prepare students to tackle complex problems faced by society.

Admission to the Major

Prospective undergraduates in the College of Engineering must apply 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

There is no minor program in engineering physics.

Other Majors offered by the Engineering Science Program

Energy Engineering (<http://guide.berkeley.edu/archive/2019-20/undergraduate/degree-programs/energy-engineering>) (Major and Minor)
Engineering Mathematics and Statistics (<http://guide.berkeley.edu/archive/2019-20/undergraduate/degree-programs/engineering-math-statistics>) (Major)

Environmental Engineering Science (<http://guide.berkeley.edu/archive/2019-20/undergraduate/degree-programs/environmental-engineering-science>) (Major)

In addition to the University, campus, and college requirements, students must fulfill the requirements listed below 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 or PHYSICS 85 Introduction to Mathematical Physics	4
CHEM 1A & 1AL	General Chemistry and General Chemistry Laboratory ³ or CHEM 4A General Chemistry and Quantitative Analysis	4
ENGIN 7	Introduction to Computer Programming for Scientists and Engineers or COMPSCI 6 The Structure and Interpretation of Computer Programs or COMPSCI 6 Data Structures or PHYSICS 77 Introduction to Computational Techniques in Physics	3-4
PHYSICS 5A	Introductory Mechanics and Relativity or PHYSICS 7A Physics for Scientists and Engineers	3-4
PHYSICS 5B & 5BL	Introductory Electromagnetism, Waves, and Optics and Introduction to Experimental Physics I or PHYSICS 7E Physics for Scientists and Engineers	5
PHYSICS 5C & 5CL	Introductory Thermodynamics and Quantum Mechanics and Introduction to Experimental Physics II or PHYSICS 7C Physics for Scientists and Engineers	5
Lower division technical electives, select three from the following:		11-14
ASTRON 7A	Introduction to Astrophysics [4]	
ASTRON 7B	Introduction to Astrophysics [4]	
BIOLOGY 1A & 1AL	General Biology Lecture and General Biology Laboratory	
BIOLOGY 1B	General Biology Lecture and Laboratory [4]	
CHEM 1B	General Chemistry [4]	
COMPSCI 70	Discrete Mathematics and Probability Theory [4]	
CHEM 3A & 3AL	Chemical Structure and Reactivity and Organic Chemistry Laboratory	
CHEM 4B	General Chemistry and Quantitative Analysis [5]	
EECS 16A	Designing Information Devices and Systems I [4]	
EECS 16B	Designing Information Devices and Systems II [4]	
MAT SCI 45	Properties of Materials [3] (MAT SCI 45L recommended)	
MEC ENG C85/ CIV ENG C30	Introduction to Solid Mechanics [3]	
ENGIN 92	Perspectives in Engineering (Optional)	1

Upper Division Requirements

Due to the interdisciplinary nature of this major, electives must be selected and approved in consultation with a faculty adviser.

MEC ENG 104	Engineering Mechanics II or PHYSICS 105 Analytic Mechanics	3-4
MEC ENG 185	Introduction to Continuum Mechanics or MEC ENG 111 Fluid Mechanics	3

PHYSICS 137A	Quantum Mechanics	4
PHYSICS 137B	Quantum Mechanics	4
Take one of the following math series:		8
MATH 104 & MATH 185	Introduction to Analysis and Introduction to Complex Analysis	
MATH 121A & MATH 121B	Mathematical Tools for the Physical Sciences and Mathematical Tools for the Physical Sciences	
Take one of the following series:		7-8
PHYSICS 110A & PHYSICS 110B	Electromagnetism and Optics and Electromagnetism and Optics	
EL ENG 117 & EL ENG 118	Electromagnetic Fields and Waves and Introduction to Optical Engineering	
MAT SCI 111 or PHYSICS 145A	Properties of Electronic Materials and Solid State Physics	4
ENGIN 40 or PHYSICS 111	Engineering Thermodynamics and Introduction to Statistical and Thermal Physics	4
PHYSICS 111A or EL ENG 143 or NUC ENG 101	Instrumentation Laboratory ¹ Microfabrication Technology and Radiation Detection and Nuclear Instrumentation Laboratory	3-4
Technical Electives ²		

¹ Students planning to pursue graduate school in physics are advised to complete PHYSICS 111B (for 3 units) to satisfy the laboratory requirement. Note: Students will need to obtain consent of the PHYSICS 111B instructor if they have not completed the prerequisites of PHYSICS 111A and PHYSICS 137A.

² Technical electives must include:

- 15 units of upper division courses in engineering. Upper division engineering units cannot include: any course taken on a Pass/No Pass basis and any of the following courses: BIO ENG 100, COMPSCI 195, COMPSCI H195, DES INV courses (except DES INV 190E), ENGIN 125, ENGIN 157AC, ENGIN 180, ENGIN 185, ENGIN 187, IND ENG 172, IND ENG 185, IND ENG 186, the IND ENG 190 series, IND ENG 191, IND ENG 192, IND ENG 195, MEC ENG 191AC, MEC ENG 190K, and MEC ENG 191K.
- A minimum of 14 units of upper-division physics.
- The 15 units of upper division engineering and 14 units of upper-division physics DO include all required upper division engineering and physics units completed. If in selecting options to meet upper division requirements the totals do not come to 15 units of ENGIN and 14 units of PHYSICS, additional units (chosen in consultation with a faculty adviser) must be added.
- At least 40 units of approved upper division technical subjects (mathematics, statistics, science, and engineering). These 40 units DO include all required upper division technical course work taken for the major.

³ CHEM 4A is intended for students majoring in chemistry or a closely related field.

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 (<http://engineering.berkeley.edu/academics/undergraduate-programs>) 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 a maximum of four semesters to complete their degree requirements. (Note: junior transfers admitted missing three or more courses from the lower division curriculum are allowed five semesters.) 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 (<http://engineering.berkeley.edu/academics/undergraduate-guide>) as they complete degree requirements.
7. Complete the lower division program before enrolling in upper division engineering 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. Follow these guidelines to fulfill this requirement:

1. Complete a minimum of six courses from the approved Humanities/Social Sciences (H/SS) lists (<http://engineering.berkeley.edu/hssreq>).
2. Courses must be a minimum of 3 semester units (or 4 quarter units).
3. Two of the six courses must fulfill the College's Reading and Composition (R&C) requirement. These 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. Please see the Reading and Composition Requirement (<http://guide.berkeley.edu/archive/2019-20/undergraduate/colleges-schools/engineering/reading-composition-requirement>) page for a complete list of R&Cs available and a list of exams that can be applied toward the R&C Part A requirement. Students can also use the Class Schedule (<https://classes.berkeley.edu>) to view R&C courses offered in a given semester. Note: Only R&C Part A can be fulfilled with an AP, IB, or A-Level exam score. Test scores do not fulfill R&C Part B for College of Engineering students.
4. The four additional courses must be chosen from the five areas listed in #13 below. These four courses may be taken on a pass/no pass basis.
5. Special topics courses of 3 semester units or more will be reviewed on a case-by-case basis.
6. Two of the six courses must be upper division (courses numbered 100-196).

7. One of the six courses must satisfy the campus American Cultures (<http://guide.berkeley.edu/archive/2019-20/undergraduate/colleges-schools/engineering/american-cultures-requirement>) (AC) requirement. Note that any American Cultures course of 3 units or more may be used to meet H/SS
8. A maximum of two exams (Advanced Placement, International Baccalaureate, or A-Level) may be used toward completion of the H/SS requirement. View the list of exams (<http://engineering.berkeley.edu/academics/undergraduate-guide/exams>) that can be applied toward H/SS requirements.
9. No courses offered by any engineering department other than BIO ENG 100, COMPSCI C79, ENGIN 125, ENGIN 157AC, ENGIN 185, and MEC ENG 191K may be used to complete H/SS requirements.
10. Language courses may be used to complete H/SS requirements. View the list of language options (<http://guide.berkeley.edu/archive/2019-20/undergraduate/colleges-schools/engineering/approved-foreign-language-courses>).
11. Courses may fulfill multiple categories. For example, CY PLAN 118AC satisfies both the American Cultures requirement and one upper division H/SS requirement.
12. Courses numbered 97, 98, 99, or above 196 may not be used to complete any H/SS requirement.
13. The College of Engineering uses modified versions of five of the College of Letters and Science (L&S) breadth requirements lists to provide options to our students for completing the H/SS requirement. The five areas are:

- Arts and Literature
- Historical Studies
- International Studies
- Philosophy and Values
- Social and Behavioral Sciences

Within the guidelines above, choose courses from any of the Breadth areas listed above. (Please note that you *cannot* use courses on the Biological Science or Physical Science Breadth list to complete the H/SS requirement.) To find course options, go to the Class Schedule (<http://classes.berkeley.edu>), (<http://classes.berkeley.edu/search/class>) select the term of interest, and use the Breadth Requirements (https://ls.berkeley.edu/sites/default/files/breadth_search_annotation_in_guide.png) filter.

Class Schedule Requirements

- Minimum units per semester: 12.0
- Maximum units per semester: 20.5
- Minimum technical courses: College of Engineering undergraduates must enroll each semester in no fewer than two technical courses (of a minimum of 3 units each, with the exception of Engineering 25, 26 and 27) required of the major program of study in which the student is officially declared. (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 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 (Grade) Requirements

- A minimum overall and semester grade point average of 2.00 (C average) is required of engineering undergraduates. 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 is needed to earn a Bachelor of Science in Engineering.

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/academics/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 towards 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/academics/undergraduate-guide/policies-procedures/scholarship-progress/#ac12283>) each semester toward the bachelor's degree. The continued enrollment of students who fail to achieve minimum academic progress shall be subject to the approval of the dean. (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 (<https://www.ucop.edu/elwr>)

All students who will enter the University of California as freshmen must demonstrate their command of the English language by fulfilling the Entry Level Writing Requirement. Satisfaction of this requirement is also a prerequisite to enrollment in all Reading and Composition courses at UC Berkeley.

American History and American Institutions (<http://guide.berkeley.edu/archive/2019-20/undergraduate/education/#universityrequirementstext>)

The American History and Institutions requirements are based on the principle that a U.S. 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/archive/2019-20/undergraduate/education/#campusrequirementstext>)

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.

The American Cultures requirement and courses constitute an approach that responds directly to the problem encountered in numerous disciplines of how better to present the diversity of American experience to the diversity of American students whom we now educate.

Faculty members from many departments teach American Cultures courses, but all courses have a common framework. The courses focus on themes or issues in United States history, society, or culture; address theoretical or analytical issues relevant to understanding race, culture, and ethnicity in American society; take substantial account of groups drawn from at least three of the following: African Americans, indigenous peoples of the United States, Asian Americans, Chicano/Latino Americans, and European Americans; and are integrative and comparative in that students study each group in the larger context of American society, history, or culture.

This is not an ethnic studies requirement, nor a Third World cultures requirement, nor an adjusted Western civilization requirement. These courses focus upon how the diversity of America's constituent cultural traditions have shaped and continue to shape American identity and experience.

Visit the Class Schedule (<http://classes.berkeley.edu>) or the American Cultures website (<http://americancultures.berkeley.edu>) for the specific American Cultures courses offered each semester. For a complete list of approved American Cultures courses at UC Berkeley and California Community Colleges, please see the American Cultures Subcommittee's website (<https://academic-senate.berkeley.edu/committees/amcult>). See your academic adviser if you have questions about your responsibility to satisfy the American Cultures breadth requirement.

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> 1AL ¹		4	MATH 1B	4
MATH 1A		4	PHYSICS 5A or 7A	3-4

Reading & Composition Part A Course ²		4	ENGIN 7, COMPSCI 61A, COMPSCI 61B, or PHYSICS 77	3-4
Humanities/Social Sciences Course ²		3-4	Technical Elective ³	3-5
Freshman Seminar or ENGIN 92 (optional)		0-1		
		15-17		13-17
			Sophomore	
	Fall	Units	Spring	Units
MATH 53		4	MATH 54	4
PHYSICS 5B & 5BL		5	PHYSICS 5C & 5CL	5
or			or	
PHYSICS 7B [4]			PHYSICS [4]	
Technical Elective ³		3-5	Technical Elective ³	3-5
Reading & Composition Part B Course ²		4	Humanities/Social Sciences Course ²	3-4
		16-18		15-18
			Junior	
	Fall	Units	Spring	Units
MEC ENG 104 or PHYSICS 105		3-4	ENGIN 40 or PHYSICS 112	4
PHYSICS 137A		4	PHYSICS 137	4
Math Series Course 1 ⁴		4	Math Series Course 2 ⁴	4
Humanities/Social Sciences Course ²		3-4	Technical Elective ³	3-4
Free Elective		3		
		17-19		15-16
			Senior	
	Fall	Units	Spring	Units
EL ENG 143, NUC ENG 104, or PHYSICS 111A ⁵		3-4	MEC ENG 185 or 106	3
MAT SCI 111 or PHYSICS 141A		4	Electromagnetism & Optics Series course 2 ⁶	3-4
Electromagnetics & Optics Series Course 1 ⁶		4	Technical Elective ³	3-4
Technical Elective ³		3-4	Humanities/Social Sciences Course ²	3-4
Free Elective		3		
		17-19		12-15
Total Units: 120-139				

¹ CHEM 4A is intended for students majoring in Chemistry or a closely-related field.

- ² 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 Humanities and Social Science Requirements (<https://engineering.berkeley.edu/academics/undergraduate-guide/degree-requirements/humanities-and-social-sciences>) for complete details and a list of approved courses.
- ³ Technical electives must include:
- Three courses from the following lower division technical electives: ASTRON 7A, ASTRON 7B, BIOLOGY 1A plus BIOLOGY 1AL, BIOLOGY 1B, CHEM 1B, CHEM 3A plus CHEM 3AL, CHEM 4B, COMPSCI 70, EECS 16A/EL ENG 16A, EECS 16B/EL ENG 16B, MAT SCI 45 (MAT SCI 45L recommended), MEC ENG C85/CIV ENG C30.
 - 15 units of upper division courses in engineering. Upper division engineering units cannot include: any course taken on a Pass/No Pass basis and any of the following courses: BIO ENG 100, COMPSCI 195, COMPSCI H195, DES INV courses (except DES INV 190E), ENGIN 125, ENGIN 157AC, ENGIN 180, ENGIN 185, ENGIN 187, IND ENG 172, IND ENG 185, IND ENG 186, the IND ENG 190 series, IND ENG 191, IND ENG 192, IND ENG 195, MEC ENG 191AC, MEC ENG 190K, and MEC ENG 191K.
 - A minimum of 14 units of upper-division physics.
 - The 15 units of upper division engineering and 14 units of upper-division physics DO include all required upper division engineering and physics units completed. If in selecting options to meet upper division requirements the totals do not come to 15 units of ENGIN and 14 units of PHYSICS, additional units (chosen in consultation with a faculty adviser) must be added.
 - At least 40 units of approved upper division technical subjects (mathematics, statistics, science, and engineering). These 40 units DO include all required upper division technical course work taken for the major.
- ⁴ Math Series: Select one sequence from the following: MATH 104 and MATH 185; or MATH 121A and MATH 121B.
- ⁵ NUC ENG 104 offered in spring only, prerequisite is NUC ENG 101. Students planning to pursue graduate school in physics are advised to complete PHYSICS 111B (for 3 units) to satisfy the laboratory requirement. Note: Students will need to obtain consent of the PHYSICS 111B instructor if they have not completed the prerequisites of PHYSICS 111A and PHYSICS 137A.
- ⁶ Electromagnetic & Optics Series: Select one sequence from the following: PHYSICS 110A and PHYSICS 110B; or EL ENG 117 and EL ENG 118.