Bioengineering

College of Engineering (http://coe.berkeley.edu)
Department Office: 306 Stanley Hall, (510) 642-5833

Chair: Kevin Healy, PhD
Department Website: Bioengineering (http://bioeng.berkeley.edu)

Overview

Bioengineering applies engineering principles and practices to living things, to solve some of the most challenging problems that face our world today. In Bioengineering, also known as Biomedical Engineering, our work is concentrated on high-impact applications instrumentation, molecular and cellular engineering, and computational biosciences that will bring about major advances in medicine and the life sciences.

Founded in 1998, the department is supported by exceptional faculty, strong ties to other departments on campus, and close collaborations with other institutions such as UC San Francisco and Lawrence Berkeley National Laboratory. We continue to expand our department with new faculty, staff, facilities, and research programs.

See the College of Engineering Undergraduate Guide (http://coe.berkeley.edu/college-of-engineering-announcement) for more information.

Undergraduate Program

Rated one of the top 10 bioengineering undergraduate programs in the country, Bioengineering at Berkeley is a multidisciplinary major intended for academically strong students who excel in the physical sciences, mathematics, and biology. Coursework provides a strong foundation in engineering and the biological sciences, with the freedom to explore a variety of topics and specialize in advanced areas of research. All students benefit from intensive group design work, either through a senior capstone project (http://bioeng.berkeley.edu/undergrad/capstone) or through independent research in faculty laboratories.

The stimulating environment of Berkeley offers a wealth of opportunity for learning, research, service, and community involvement, and provides dedicated students the knowledge and skills to become the next leaders in bioengineering.

Our major features small, specialized upper division courses and direct interaction with faculty. We offer six distinct concentrations: Biomaterials, Biomechanics and Cell & Tissue Engineering; Biomedical Devices; Computational Bioengineering; Imaging; Premed; and Synthetic Biology.

Major Requirements

Students must complete a minimum of 120 units, in which they must satisfy the University of California and Berkeley campus requirements outlined in this Bulletin. In addition, students must complete the requirements for the College of Engineering and the bioengineering program. Full details on these requirements can be found in the College of Engineering Undergraduate Guide (http://bulletin.berkeley.edu/departmentsandsubjects/bioengineering/See%20the%20College%20of%20Engineering%20Undergraduate%20Guide%20for%20more%20information.html) .

Undergraduate Program in Bioengineering * (p.)

Course	Fall	Spring
Freshman Year		
Chemistry 1A and 1AL – General Chemistry or Chemistry 4A – General Chemistry and Quantitative Analysis (1 (p.))	4	-
Chemistry 3A and 3AL – Chemical Structure and Reactivity or Chemistry 112A – Organic Chemistry (1 (p.))	-	5
BioE 10 – Introduction to Biomedicine for Engineers (12 (p.))	4	-
E 7 – Introduction to Computer Programming for Scientists & Engineers or CS 61A – Structure and Interpretation of Computer Programs	-	4
Mathematics 1A – Calculus	4	-
Mathematics 1B – Calculus	-	4
Physics 7A – Physics for Scientists and Engineers	-	4
Seminar: BioE 24 – Aspects of Bioengineering and BioE 25 – Careers in Biotechnology (2 (p.))	1	1
Reading and Composition Course from List A (3 (p.))	4	-
Total	**17**	**18**
Sophomore Year		
Biology 1A and 1AL – General Biology	-	5
Engineering/Biology Preparation (4 (p.))	3	3
Mathematics 53 – Multivariable Calculus	4	-
Mathematics 54 - Linear Algebra and Differential Equations	-	4

Physics 7B – Physics for Scientists and Engineers	4	-
Reading and Composition Course from List B (3 (p.))	4	-
Total	**15**	**12**
Junior Year		
Bioengineering Fundamentals (see concentrations for recommendations) (5 (p.))	4	4
Engineering Topic (see concentrations for recommendations) (6 (p.))	3	-
Technical Electives (see concentrations for recommendations) (7 (p.))	4	3
Upper division biology elective (see concentrations for recommendations) (8 (p.))	-	3
First Additional Humanities/Social Science Course (2 (p.) ,3 (p.))	3-4	-
BioE 100 – Ethics in Science and Engineering or Second Additional Humanities/ Social Science Course (with Ethics Content) (2 (p.) ,3 (p.))	-	3-4
Total	**14-15**	**13-14**
Senior Year		
Bioengineering Lab Course (11 (p.))	4	-
Bioengineering Topics (see concentrations for recommendations) (9 (p.))	4	4
Engineering Topic (see concentrations for recommendations) (6 (p.))	-	4
Technical Elective (see concentrations for recommendations) (7 (p.))	3	-
Bioengineering Design Project or Research (10 (p.))	-	4
Third and Fourth Additional Humanities/ Social Science Courses (2 (p.) ,3 (p.))	3-4	3-4
Total	**14-15**	**15-16**

Notes

[1] Chemistry 4A and 112A/B are intended for students majoring in chemistry or a closely related field. *Note:* Prerequisites to Chemistry 112A/B include Chemistry 1A and Chemistry 1B (or Chemistry 4A and Chemistry 4B).

[2] This requirement may be completed at any time in the program.

[3] The Humanities/Social Science (H/SS) requirement includes two approved reading and composition courses and four additional approved courses, with which a number of specific conditions must be satisfied. Reading and Composition "A" and "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 the website (http://coe.berkeley.edu/hssreq) for complete details and a list of approved courses. Consult the "Ethics Content List" on the previous page for courses with ethics content.

[4] Select two from the Engineering/Biology Preparation list (http://bioeng.berkeley.edu/undergrad/program/engbioprep) .

[5] Choose courses from the approved Bioengineering Fundamentals list (http://bioeng.berkeley.edu/undergrad/program/bioefundamentals) .

[6] Choose courses from the approved Engineering Topics list (http://bioeng.berkeley.edu/undergrad/program/engtopics) .

[7] Choose courses from the approved Technical Elective list (http://bioeng.berkeley.edu/undergrad/program/techelect) . Pre-Med students should take Chemistry 3B/3BL and Biology 1B.

[8] Choose courses from the approved Upper Division Biology list (http://bioeng.berkeley.edu/undergrad/program/udbiology) .

[9] Choose courses from the Bioengineering Topics list (http://bioeng.berkeley.edu/undergrad/program/engtopics) .

[10]Choose course from Bioengineering Design Project or Research list (http://bioeng.berkeley.edu/undergrad/program/design) .

[11] Choose course from Bioengineering Lab list (http://bioeng.berkeley.edu/undergrad/program/bioelabs) .

* Program of study must include:
(a) 42 units of upper-division coursework in technical subjects such as engineering, chemistry, physics, integrative biology, molecular and cell biology, mathematics, or statistics. Of these units, at least 22 must be in bioengineering. The 42 units must be from the bioengineering core curriculum (excluding BioE 100) or the Curriculum Electives lists.
(b) 45 units of engineering (upper or lower division). These units must be from courses that appear on the Bioengineering Topics or Engineering Topics lists.
Students are advised to consult the approved concentrations (http://bioeng.berkeley.edu/undergrad/program/concentrations) to identify an appropriate course sequence for bioengineering specialty areas, and may also design their own program that meets with the above requirements with permission from their faculty adviser. Regular consultation with an adviser is strongly encouraged. Recommended courses for each concentration can be found here. (http://bioeng.berkeley.edu/undergrad/program/concentrations)

[12] Junior Transfer admits are exempt from completing BIOE 10
* A minimum of 120 units is required for graduation.

Joint Major in Bioengineering/Materials Science and Engineering

The Department of Bioengineering offers a joint major with The Department of Materials Science and Engineering for students who have an interest in the field of biomaterials. The broad curriculum includes exposure to fundamental courses in engineering and life sciences and will allow students to understand the interface between the two major fields. Students taking this joint major will successfully compete for jobs in the field of biomaterials in academia, industry, and government.

Bioengineering Minor

The department offers a minor in bioengineering that is open to all students who are not majoring in bioengineering and who have completed the necessary prerequisites for the minor requirements. Information is available in 306 Stanley Hall.

Graduate Program

The Department of Bioengineering offers two professional Master's degrees and a joint PhD program.

The (http://bioeng.berkeley.edu/meng)**Master of Engineering (MEng)** is a one-year masters degree with a strong emphasis on engineering and entrepreneurship designed for students planning to move directly into industry after completing the program.

The (http://bioeng.berkeley.edu/mtm)**Master of Translational Medicine (MTM) program** links the Department of Bioengineering at Berkeley with the Department of Bioengineering and Therapeutic Sciences at UCSF, and is designed to train students in applying translational research and engineering approaches to solve fundamental problems in healthcare delivery. This one-year program should appeal to engineers, scientists and clinicians who seek to bring innovative treatments and devices into clinical use.

The (http://bioegrad.berkeley.edu)**PhD in Bioengineering** is granted jointly by Berkeley and UCSF, two of the top public universities in the world in health sciences and engineering. Our interdisciplinary program combines the outstanding resources in biomedical and clinical sciences at UCSF with the excellence in engineering, physical, and life sciences at Berkeley.

All students have full access to the breadth of resources and courses on both campuses, and the opportunity to work with over 100 affiliated faculty in the colleges of engineering, chemistry and biological sciences at Berkeley and medical and dental schools at UCSF. Our program offers students unparalleled opportunities for fundamental and applied bioengineering research in a wide variety of related fields. Innovation and collaboration across campuses and disciplines is encouraged, and often led by graduate students.

Students with a BA or BS degree in engineering, biology, or other science are eligible for admission. Students can obtain additional information and application materials by contacting the Bioengineering Graduate Program, 306 Stanley Hall, University of California, Berkeley; Berkeley, CA 94720-1762. Phone: (510) 642-9931. Website: bioegrad.berkeley.edu (http://bioegrad.berkeley.edu) .

BIO ENG 10 Introduction to Biomedicine for Engineers 4 Units
Department: Bioengineering
Course level: Undergraduate
Term course may be offered: Fall
Grading: Letter grade.
Hours and format: 3 hours of Lecture and 1 hour of Discussion per week for 15 weeks.
This course is intended for lower division students interested in acquiring a foundation in biomedicine with topics ranging from evolutionary biology to human physiology. The emphasis is on the integration of engineering applications to biology and health. The goal is for undergraduate engineering students to gain sufficient biology and human physiology fundamentals so that they are better prepared to study specialized topics, e.g., biomechanics, imaging, computational biology, tissue engineering, biomonitoring, drug development, robotics, and other topics covered by upper division and graduate courses in UC Berkeley departments of Molecular and Cell Biology, Integrative Biology, Bioengineering, Electrical Engineering and Computer Science, Mechanical Engineering, and courses in the UC San Francisco Division of Bioengineering. The specific lecture topics and exercises will include the key aspects of genomics and proteomics as well as topics on plant and animal evolution, stem cell biomedicine, and tissue regeneration and replacement. Medical physiology topics include relevant engineering aspects of human brain, heart, musculoskeletal, and other systems.
Instructors: Conboy, Kumar

BIO ENG 22 Biotechnology 3 Units
Department: Bioengineering
Course level: Undergraduate
Term course may be offered: Fall
Grading: Letter grade.
Hours and format: 3 hours of Lecture per week for 15 weeks.
Prerequisites: 22L (must be taken concurrently).
This course is intended to introduce students to a variety of fields that fall under the biotechnology umbrella. In general, these fields include medical, microbial, agricultural, animal, and forensic biotechnology. Students in this course will learn the types of biotechnology projects currently being worked on, as well as the techniques and assays used within these projects.
Instructors: L. Lee, Dueck

BIO ENG 22L Biotechnology Laboratory 2 Units
Department: Bioengineering
Course level: Undergraduate
Term course may be offered: Fall
Grading: Letter grade.
Hours and format: 6 hours of Laboratory per week for 15 weeks.
Prerequisites: 22 (must be taken concurrently).
This course is intended to introduce students to a variety of laboratory techniques that are used in current day biotechnology projects.
During this course, students will get hands-on molecular and cellular biotechnology experience working with E. coli, Yeast, Human and Mouse Cell Lines, DNA, RNA, and proteins. This is a bioengineering course; the focus of these exercises will be on the critical understanding of biological, biochemical, or physical mechanisms, and theories of different experiemental methods, techniques, and instrumentation used. Second, students leaving this class should understand how to address a critical biological question and design experiments in a quantitative manner.
Instructors: L. Lee, Dueck

BIO ENG 24 Aspects of Bioengineering 1 Unit
Department: Bioengineering
Course level: Undergraduate
Terms course may be offered: Fall and spring
Grading: Offered for pass/not pass grade only.
Hours and format: 1 hour of Seminar per week for 15 weeks.