Bioengineering (BIOE)

Completion of the undergraduate program in Bioengineering leads to the conferral of the Bachelor of Science in Bioengineering.

Mission of the Undergraduate Program in Bioengineering

The Stanford Bioengineering major enables students to combine engineering and the life sciences in ways that advance scientific discovery, healthcare and medicine, manufacturing, environmental quality, culture, education, and policy. Students who major in BioE earn a fundamental engineering degree for which the raw materials, underlying basic sciences, fundamental toolkit, and future frontiers are all defined by the unique properties of living systems.

Students will complete engineering fundamentals courses, including an introduction to bioengineering and computer programming. A series of core BIOE classes beginning in the second year leads to a student-selected depth area and a senior capstone design project. The department also organizes a summer Research Experience for Undergraduates (REU) (http://bioengineering.stanford.edu/student-resources/reu) program. BIOE graduates are well prepared to pursue careers and lead projects in research, medicine, business, law, and policy.

Requirements

Mathematics

14 units minimum (Prerequisites: 10 units of AP or IB credit or Mathematics 20-series)  

Select one of the following sequences:

CME 100  
Vector Calculus for Engineers  
and Ordinary Differential Equations for Engineers (Recommended)  

Select one of the following:

MATH 110  
Linear Algebra, Multivariable Calculus, and Modern Applications  
and Ordinary Differential Equations with Linear Algebra  

Science

26 units minimum

CHEM 31M  
Chemical Principles: From Molecules to Solids (formerly 31X)  
or CHEM 31A  
Chemical Principles I and Chemical Principles II  

CHEM 33  
Structure and Reactivity of Organic Molecules  

BIO 83  
Biochemistry & Molecular Biology (Recommended)  

or BIO 82  
Genetics  

BIO 84  
Physiology  

Units

Physics 41  
Mechanics  

Physics 43  
Electricity and Magnetism  

Technology in Society

BIO 131  
Ethics in Bioengineering (WIM)  

Engineering Fundamentals

BIOE 80  
Introduction to Bioengineering (Engineering Living Matter)  

CS 106A  
Programming Methodology (or CS 106B or CS 106X)  

Fundamentals Elective; see UGHB for approved course list; only one CS class allowed to count toward Fundamentals requirements.

Bioengineering Core

BIOE 42  
Physical Biology  

BIOE 44  
Fundamentals for Engineering Biology Lab  

BIOE 101  
Systems Biology  

BIOE 103  
Systems Physiology and Design  

BIOE 123  
Biomedical System Prototyping Lab  

BIOE 141A  
Senior Capstone Design I  

BIOE 141B  
Senior Capstone Design II  

Bioengineering Depth Electives

Four courses, minimum 12 units:

BIOE 122  
Biosecurity and Bioterrorism Response  

BIOE 201C  
Biophysics of Multi-cellular Systems and Amorphous Computing  

BIOE 212  
Introduction to Biomedical Informatics Research Methodology  

BIOE 221  
Biophysics of Radionuclide-based Medical Imaging  

BIOE 222  
Physics and Engineering Principles of Multi-modality Molecular Imaging of Living Subjects  

BIOE 223  
Physics and Engineering of X-Ray Computed Tomography  

BIOE 224  
Probes and Applications for Multi-modality Molecular Imaging of Living Subjects  

BIOE 225  
Ultrasound Imaging and Therapeutic Applications  

BIOE 227  
Functional MRI Methods  

BIOE 231  
Protein Engineering  

BIOE 244  
Advanced Frameworks and Approaches for Engineering Integrated Genetic Systems  

BIOE 260  
Tissue Engineering  

BIOE 279  
Computational Biology: Structure and Organization of Biomolecules and Cells  

BIOE 281  
Biomechanics of Movement  

BIOE 291  
Principles and Practice of Optogenetics for Optical Control of Biological Tissues  

Total Units  

104-107

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It is strongly recommended that CME 100 Vector Calculus for Engineers and CME 102 Ordinary Differential Equations for Engineers be taken rather than MATH 51 Linear Algebra, Multivariable Calculus, and Modern Applications and MATH 53 Ordinary Differential Equations with Linear Algebra. If you are taking the MATH 50 series, it is strongly recommended to take CME 192 Introduction to MATLAB. CME 106 Introduction to Probability and Statistics for Engineers utilizes MATLAB, a powerful technical computing program, and should be taken rather than STATS 110 Statistical Methods in Engineering and the Physical Sciences or STATS 141 Biostatistics. Although not required, CME 104 Linear Algebra and Partial Differential Equations for Engineers is recommended for some Bioengineering courses.

Science must include both Chemistry (CHEM 31A Chemical Principles I and CHEM 31B Chemical Principles II; or CHEM 31M Chemical Principles: From Molecules to Solids) and calculus-based Physics (PHYSICS 41 Mechanics and PHYSICS 43 Electricity and Magnetism), with two quarters of course work in each, in addition to two courses of BIO core. CHEM 31A Chemical Principles I and CHEM 31B Chemical Principles II are considered one course even though given over two quarters.

A course may only be counted towards one requirement; it may not be double-counted. All courses taken for the major must be taken for a letter grade if that option is offered by the instructor. Minimum Combined GPA for all courses in Engineering Fundamentals and Depth is 2.0.

For additional information and sample programs see the Handbook for Undergraduate Engineering Programs (UGHB) (http://ughb.stanford.edu). Students pursuing a premed program need to take additional courses; see the UGHB, BioE Premed 4-Year Plan.

**Honors Program**

The School of Engineering offers a program leading to a Bachelor of Science in Bioengineering with Honors (BIOE-BSH). This program provides the opportunity for qualified BioE majors to conduct independent research at an advanced level with a faculty research adviser and documented in an honors thesis.

In order to receive departmental honors, students admitted to the program must:

1. Declare the honors program in Axess (BIOE-BSH).
2. Maintain an overall grade point average (GPA) of at least 3.5 as calculated on the unofficial transcript.
3. Complete at least two quarters of research with a minimum of nine units of BIOE 191 Bioengineering Problems and Experimental Investigation or BIOE 191X Out-of-Department Advanced Research Laboratory in Bioengineering for a letter grade; up to three units may be used towards the bioengineering depth elective requirements.
4. Students submit a pdf of their thesis, including the signature page signed by both readers, to the student services officer by May 15. Students are sent email instructions on how to archive a permanent electronic copy in Terman Engineering library.
5. Attend and present thesis synopsis at the Bioengineering Honors Poster Fair at the end of Spring Quarter.

For more information and application instructions, see the Bioengineering Honors Program (http://bioengineering.stanford.edu/academics/undergraduate-programs/bioengineering-honors-program) web site.