

BIOMEDICAL ENGINEERING (BS)

Offered at: San Luis Obispo Campus

Biomedical engineering is an interdisciplinary field in which the principles and tools of traditional engineering fields, such as mechanical, materials, electrical, and chemical engineering, are applied to biomedical problems. Engineering plays an increasingly important role in medicine in projects that range from basic research in physiology to advances in medical devices, biotechnology, and the improvement of health care delivery. By its very nature, biomedical engineering is broad and requires a foundation in the engineering sciences as well as in physiology and other biological sciences.

The BS degree program in Biomedical Engineering is accredited by the Engineering Accreditation Commission of ABET (<http://www.abet.org/>).

Concentrations

Bioinstrumentation

Offered at: San Luis Obispo Campus

The bioinstrumentation concentration prepares students for entry level jobs in the medical device industry where a deeper understanding of electrical engineering skills are necessary.

Cell Therapy

Offered at: San Luis Obispo Campus

The cell therapy concentration prepares students for employment in the biotechnology and regenerative medicine industry, with specific focus on the cell therapy field.

Mechanical Design

Offered at: San Luis Obispo Campus

The mechanical design concentration prepares students for employment in the product development, design, or manufacturing fields in the medical device industry.

Individualized Course of Study

Offered at: San Luis Obispo Campus

An Individualized Course of Study in Biomedical Engineering is also an option. It is not a formal concentration. Students instead select support and technical elective coursework in consultation with a faculty advisor. Those who do not declare a concentration will default to the Individualized Course of Study.

Program Learning Objectives

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objective.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Degree Requirements and Curriculum

In addition to the program requirements listed on this page, students must also satisfy requirements outlined in more detail in the Minimum Requirements for Graduation (<https://catalog.calpoly.edu/academic-standards-policies/general-requirements-bachelors-degree/>) section of this catalog, including:

- 40 units of upper-division courses
- 2.0 GPA
- Graduation Writing Requirement (GWR)
- U.S. Cultural Pluralism (USCP)

Note: No Major or Support courses may be selected as credit/no credit. In addition, no more than 12 units of cooperative or internship courses can count towards your degree requirements.

Code	Title	Units
MAJOR COURSES		
BMED 1101	Introduction to Biomedical Engineering	1
BMED 2212	Introduction to Mechanical Design in Biomedical Engineering	3
BMED 2310	Introduction to Electrical Design in Biomedical Engineering	2
BMED 2311	Introduction to Electrical Design in Biomedical Engineering Lab	1
BMED 2420	Principles and Applications of Biomaterials	4
BMED 3102	Biomedical Engineering Professional Development	1
BMED 3410	Biomechanics	3
BMED 3425	Biomedical Engineering Transport	4
BMED 3430	Biomedical Modeling and Simulation	2
BMED 4440	Bioelectronics and Instrumentation	3
BMED 4460	Medical Physiology for Engineers	3
BMED 4465	Senior Project: Design I	2
BMED 4466	Senior Project: Design II	2
Concentration or Individualized Course of Study		
(See list of Concentrations and Individualized Course of Study below)		18-19
SUPPORT COURSES		
BIO 1151	Life: Molecules and Cells (5B & 5C) ¹	4
BIO 2231	Human Anatomy and Physiology I	4
or BIO 2232	Human Anatomy and Physiology II	
CHEM 1120	Fundamentals of Chemical Structure and Properties (5A) ¹	4
CHEM 1122	Fundamentals of Chemical Reactivity	4
ENGR 2211	Introduction to Mechanics	4
ENGR 2212	Introduction to Engineering Dynamics	2
MATH 1261	Calculus I (2) ¹	4
MATH 1262	Calculus II	4
MATH 2263	Calculus III	3
MATH 2341	Linear Analysis	4
ME 3341	Fluid Mechanics	3
PHYS 1141	General Physics I	4
PHYS 1143	General Physics II	4
STAT 3210	Engineering Statistics (Upper-Division 2/5) ¹	3
GENERAL EDUCATION (GE)		
(See GE program requirements below)		30
FREE ELECTIVES		
Free Electives		0
Total Units		130-131

¹ Required in Major or Support; also satisfies General Education (GE) requirement.

Concentrations

Bioinstrumentation

Code	Title	Units
REQUIRED COURSES		
BMED 3355	Electrical Engineering Concepts for Biomedical Engineering	3
BMED 4445	Biopotential Instrumentation	3
MATH 3351	Differential Equations and Boundary Value Problems	3
Technical Electives		
Select from the following:		10

BMED 4432	Microfluidics/MEMS Design
BMED 4433	Microfluidics/MEMS Design and Fabrication Laboratory
BMED 4434	Micro/Nano Fabrication
BMED 4435	Micro/Nano Fabrication Laboratory
BMED 5505	Biomedical Signal Transduction and Data Acquisition
BMED 5515	Biomedical Imaging
BMED 5555	Introduction to Computational Neuroscience
PHYS 2211	General Physics III: Modern Physics
PHYS 3323	Optics
PHYS 4425	Solid State Physics

Total Units
19

Cell Therapy

Code	Title	Units
REQUIRED COURSES		
BIO 3351	Principles of Genetics	3
BIO 4456	Immunology	4
BIO 4457	Molecular Biology Laboratory	3
BMED 3360	Cellular Immunotherapy	3
BMED 3362	Regenerative Medicine Therapies	3
Technical Electives		
Select from the following:		3
BMED 4432	Microfluidics/MEMS Design	
BMED 4434	Micro/Nano Fabrication	
BMED 4435	Micro/Nano Fabrication Laboratory	
BMED 4480	Drug Discovery and Development	
BMED 4499	Senior Thesis	
BMED 5510	Principles of Tissue Engineering	
BMED 5515	Biomedical Imaging	
BMED 5560	Cell Transplantation and Biotherapeutics	
BMED 5561	Cell Transplantation and Biotherapeutics Laboratory	

Total Units
19

Mechanical Design

Code	Title	Units
REQUIRED COURSES		
BMED 3330 or ME 3329	Intermediate Biomedical Design Mechanical Systems Design	3
IME 1140	Technical Graphics Communication for Design and Manufacturing	1
IME 1143	Introduction to Design and Manufacturing	2
ME 3328	Design for Strength and Stiffness	4
Support Electives		
Select from the following:		3-4
BIO 3312	Human Genetics	
IME 1141 or IME 1142	Introduction to Metal Casting and Prototyping Materials Joining	
Technical Electives		
Select from the following:		5-6
BMED/CE/ME 4404	Applied Finite Element Analysis	
BMED 5525	Skeletal Tissue Mechanics	
IME 4435	Reliability for Design and Testing	
IME 5527	Design of Experiments for Industrial Applications	

ME 3313	Intermediate Dynamics
ME 4401	Advanced Strength of Materials
ME 4402	Orthopedic Biomechanics
ME 4480	Composite Materials Analysis and Design

Total Units **18-19**

Individualized Course of Study

Code	Title	Units
------	-------	-------

REQUIRED COURSES

Support Electives

Select from the following: 9-10

BIO 2232	Human Anatomy and Physiology II
BIO 3312	Human Genetics
BIO 3351	Principles of Genetics
BIO 4451	Bioinformatics Applications
BIO 4452	Cell Biology
BUS 3310	Introduction to Entrepreneurship
CHEM 2240	Organic Chemistry: Fundamentals and Applications
CHEM 3350	Biochemistry: Fundamentals and Applications
IME 3327	Test Design and Analysis in Manufacturing Engineering
MATE 1220	Principles of Materials Engineering for Non-Majors
MATE 1215	Materials Laboratory I
MATH 3351	Differential Equations and Boundary Value Problems
MCRO 2224	General Microbiology I

Technical Electives

Select from the following: 9-10

BMED 3355	Electrical Engineering Concepts for Biomedical Engineering
BMED/CE/ME 4404	Applied Finite Element Analysis
BMED 4422	Medical Device Evaluation and FDA Regulatory Processes
BMED 4432	Microfluidics/MEMS Design
BMED 4433	Microfluidics/MEMS Design and Fabrication Laboratory
BMED 4434	Micro/Nano Fabrication
BMED 4435	Micro/Nano Fabrication Laboratory
BMED 4445	Biopotential Instrumentation
BMED 4470	Special Advanced Topics
BMED 4471	Special Advanced Laboratory
BMED 4499	Senior Thesis
BMED 5510	Principles of Tissue Engineering
BMED 5515	Biomedical Imaging
BMED 5525	Skeletal Tissue Mechanics
BMED 5530	Advanced Issues in Biomaterials
BMED 5535	Bioseparations and Clinical Diagnostics
BMED 5550	Current and Evolving Topics in Biomedical Engineering
IME 4435	Reliability for Design and Testing
IME 5527	Design of Experiments for Industrial Applications
MATE 3401	Advanced Materials Characterization
MATE 4410	Nanoscale Materials
ME 3313	Intermediate Dynamics
ME 4403	Access by Design: Introduction to Rehabilitation Engineering

Total Units **18-19**

General Education (GE) Requirements

- 43 units required, 13 of which are specified in Major and/or Support.
- If any of the remaining 30 Units is used to satisfy a Major or Support requirement, additional units of Free Electives may be needed to complete the total units required for the degree.
- See the complete GE course listing (<https://catalog.calpoly.edu/academic-standards-policies/general-requirements-bachelors-degree/#generaleducationtext>).
- A grade of C- or better is required in one course in each of the following GE Areas: 1A (English Composition), 1B (Critical Thinking), 1C (Oral Communication), and 2 (Mathematics and Quantitative Reasoning).

Lower-Division General Education

Area 1	English Communication and Critical Thinking	
1A	Written Communication	3
1B	Critical Thinking	3
1C	Oral Communication	3
Area 2	Mathematics and Quantitative Reasoning	
2	Mathematics and Quantitative Reasoning (3 units in Support) ¹	0
Area 3	Arts and Humanities	
3A	Arts	3
3B	Humanities: Literature, Philosophy, Languages other than English	3
Area 4	Social and Behavioral Sciences (Area 4 courses must come from at least two different course prefixes.)	
4A	American Institutions (Title 5, Section 40404 Requirement)	3
4B	Social and Behavioral Sciences	3
Area 5	Physical and Life Sciences	
5A	Physical Sciences (3 units in Support) ¹	0
5B	Life Sciences (3 units in Support) ¹	0
5C	Laboratory (may be embedded in a 5A or 5B course) (1 units in Support) ¹	0
Area 6	Ethnic Studies	
6	Ethnic Studies	3

Upper-Division General Education

Upper-Division 2/5	Mathematics and Quantitative Reasoning or Physical and Life Sciences (3 units in Support) ¹	0
Upper-Division 3	Arts and Humanities	3
Upper-Division 4	Social and Behavioral Sciences (Area 4 courses must come from at least two different course prefixes.)	3

Total Units	30
--------------------	-----------

¹ Required in Major or Support; also satisfies General Education (GE) requirement.

Coming soon