

BIOENGINEERING, BS

Introduction

Please click here (<http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-engineering-design-computing/bioengineering/>) to see Bioengineering department information.

The undergraduate program at CU Denver is a highly rigorous program instilling competencies in biomedical science, engineering, and mathematics and biomedical design, while emphasizing the professional competencies of leadership, communication, presentation and critical problem solving. Our mission is to improve human health through the application of engineering principles, ideas, methods and inventions to solve important clinical problems. Bioengineering is a highly interdisciplinary field that brings together:

1. engineering and mathematics
2. biological, chemical and physical sciences
3. clinical medicine

The undergraduate bioengineering program provides training at both the Denver campus and the Anschutz Medical Campus.

Graduates of the undergraduate program in bioengineering are expected to attain at least one of the following objectives within a few years after graduation:

1. Be employed as a professional in the biomedical engineering field or related industry using knowledge and skills obtained in the program.
2. Be progressing toward an advanced degree in:
 - a. health sciences or medical school
 - b. graduate school
 - c. business or law school, or other advanced professional programs.

Program Educational Objectives (PEOs) can be found on the department's website.

Program Delivery

- This is an on-campus program.
- Upper-division major courses will be taught at the Anschutz Medical Campus.

Declaring This Major

- Click here (<http://catalog.ucdenver.edu/cu-denver/undergraduate/records-registration/registration/declare-change-major-minor/>) to go to information about declaring a major.
- Students can be admitted to the bioengineering major by meeting the incoming freshmen, transfer and Intra-University Transfer (IUT) (<http://catalog.ucdenver.edu/cu-denver/undergraduate/records-registration/registration/declare-change-major-minor/>) Admissions guidelines.

General Requirements

To earn a degree, students must satisfy all requirements in each of the three areas below, in addition to their individual major requirements.

- CU Denver General Graduation Requirements (<http://catalog.ucdenver.edu/cu-denver/undergraduate/graduation/general-graduation-requirements/>)

- CU Denver Core Curriculum (<http://catalog.ucdenver.edu/cu-denver/undergraduate/graduation-undergraduate-core-requirements/>)
- College of Engineering, Design and Computing Graduation Requirements (<http://catalog.ucdenver.edu/cu-denver/undergraduate/schools-colleges-departments/college-engineering-design-computing/#graduationrequirements>)
- Click here (<http://catalog.ucdenver.edu/cu-denver/undergraduate/academic-policies-procedures/>) for information about Academic Policies

Program Requirements

The bioengineering major requirements include three different types of courses: downtown courses, upper-division bioengineering courses, and technical electives.

Downtown Courses; Students must complete all 58 credits of math, biology, chemistry, physics and lower-division bioengineering requirements with a C- or higher prior to transitioning to the Anschutz Medical Campus. Credit for some of these courses may be achieved through high school Advanced Placement (AP) course work and exams, International Baccalaureate (IB) coursework and exams, as well as transfer credit.

Code	Title	Hours
Mathematics		
MATH 1401	Calculus I	4
MATH 2411	Calculus II	4
MATH 2421	Calculus III	4
MATH 3195	Linear Algebra and Differential Equations	4
Biology		
BIOL 2010	Organisms to Ecosystems (Gen Bio)	3
BIOL 2011	Organisms to Ecosystems Lab (Gen Bio)	1
BIOL 2020	Molecules to Cells (Gen Bio)	3
BIOL 2021	Molecules to Cells Lab (Gen Bio)	1
Chemistry		
CHEM 2031	General Chemistry I	3
CHEM 2038	General Chemistry Laboratory I	1
CHEM 2061	General Chemistry II	3
CHEM 2068	General Chemistry Laboratory II	2
CHEM 3411	Organic Chemistry I	4
CHEM 3418	Organic Chemistry Lab I	1
Physics		
PHYS 2311	General Physics I: Calculus-Based	4
PHYS 2321	Intro Experimental Phys Lab I	1
PHYS 2331	General Physics II: Calculus-Based	4
PHYS 2341	Intro Experimental Phys Lab II	1
Other Courses		
ENGR 1200	Fundamentals of Engineering Design Innovation	3
BIOE 1020	Bioengineering Design and Prototyping II	3
BIOE 2010	Introduction to Programming for Bioengineers	2
BIOE 2020	Introduction to Computational Methods for Bioengineers	2
Upper-Division Bioengineering ¹		
BIOE 3010	Bioinstrumentation	3
BIOE 3020	Introduction to Biomechanical Analysis	3
BIOE 3030	Introduction to Biomaterials	3

BIOE 3040	Physiology for Bioengineering	3
BIOE 3050	Cell & Molecular Bioengineering	3
BIOE 3051	Cell & Molecular Bioengineering Lab	1
BIOE 3060	Biostatistics, Measurement and Analysis	3
BIOE 3070	Bioengineering Lab I	3
BIOE 3071	Bioengineering Lab II	3
BIOE 3090	Introduction to BioDesign	3
BIOE 4035	Undergraduate BioDesign II	3
BIOE 4045	BioDesign III	3

Bioengineering Technical Electives

Select 12 credit hours	12
Option I - Approved Technical Electives (p. 2)	
Option II - Petition Courses (p. 2)	
Total Hours	104

¹ Upper-division major classes will be taught at the Anschutz Medical Campus. These classes build upon the downtown coursework and provide the next level of instruction in bioengineering. Student can enroll in these courses once they have completed the downtown courses with a C- or higher and are in good academic standing.

Bioengineering Technical Electives Guidelines

Bioengineering students are required to take 12 credit hours of technical electives to complete their undergraduate degree. Technical electives are upper-division (3000 or 4000-level) or graduate (5000+) bioengineering courses taken after matriculation to the pre-bioengineering major. Students are responsible for meeting all prerequisites for technical electives.

Students may select any combination of approved BIOE courses for technical electives or by petition, which requires approval from the Bioengineering Undergraduate Affairs Committee. Petitions are required for selecting a BIOE course not currently approved or to take more than three credit hours of non-bioengineering courses.

Option I - Approved Technical Electives

Students may select any combination of approved Bioengineering (BIOE) courses and up to three credit hours of non-bioengineering courses.

Code	Title	Hours
BIOE 4XXX-5XXX		3
BIOE 4XXX-5XXX		3
BIOE 4XXX-5XXX		3
BIOE 4XXX-5XXX or approved non BIOE 4XXX-5XXX		3

BS/MS students are required to take BIOE 5010 Cell and Molecular Biology for Bioengineers or BIOE 5011 Systems Physiology for Bioengineers and BIOE 5020 Analytics and Machine Learning in Bioengineering as 6 of the 12 credits that apply as Technical Electives and MS coursework.

Code	Title	Hours
BIOE 5010	Cell and Molecular Biology for Bioengineers	3
or BIOE 5011	Systems Physiology for Bioengineers	
BIOE 5020	Analytics and Machine Learning in Bioengineering	3
BIOE 4XXX-5XXX		3
BIOE 4XXX-5XXX or approved non-BIOE 4XXX-5XXX		3

Option II - Petition Courses

Students may petition to have up to 6 credit hours of non-bioengineering courses (upper division) for technical electives. (CHEM, MATH, BIOL, MECH, ELEC).

Code	Title	Hours
BIOE 4XXX-5XXX		3
BIOE 4XXX-5XXX		3
Non-BIOE 4XXX-5XXX		3
Non-BIOE 4XXX-5XXX (must petition a second non-BIOE course)		3

Students may also petition to have a non-bioengineering course added to the approved list by submitting a current syllabus as part of the petition process.

Approved Bioengineering Technical Electives

Code	Title	Hours
BIOE 4039/5039	Mechatronics and Embedded Systems (Fall)	3
BIOE 4053/5053	Optics and Microscopy in Biomedical Research (Spring)	3
BIOE 4054	Regulatory Affairs (Fall)	3
or BIOE 5054	Regulatory Affairs	
BIOE 4057/5057	Rehabilitation and Assistive Technology (Fall)	3
BIOE 4063/5063	3D Modeling for Bioengineers (Fall)	3
BIOE 4064/5064	Advanced MatLab For Bioengineers And Life Scientists (Fall)	3
BIOE 4067/5067	Human Factors and Usability Testing for Bioengineers (Spring)	3
BIOE 4068/5068	Introduction to Medical Imaging	3
BIOE 4069/5069	Advanced Biomechanics for Undergraduates (Fall)	3
BIOE 4073/5073	Neural Interfaces and Bionic Limbs	3
BIOE 4083/5083	Polymers in Biomedical Applications (Spring)	3

Special Topics

Code	Title	Hours
BIOE 4420/5420	Special Topics in Bioengineering (Intro to Design, Disability and Aging (Spring))	1-3
BIOE 4420/5420	Special Topics in Bioengineering (Medical Device Life Cycle (Spring))	1-3
BIOE 4420/5420	Special Topics in Bioengineering (Bioengineering Design Hack for Global Health (Winterim))	1-3

Note: Special Topics offerings can change each semester. Review Course offerings on UCD Access for current offerings. All BIOE 4420 Special Topics in Bioengineering/BIOE 5420 Special Topics in Bioengineering courses can apply towards Technical Electives.

Internship/Independent Study/Research

Code	Title	Hours
BIOE 3939	Undergraduate Internship	1-6
BIOE 4840	Independent Study in Bioengineering	1-6
BIOE 4929	Undergraduate Research Project ¹	1-6

¹ Student can utilize no more than 3 credits hours of combined research and independent study towards technical electives.

Graduate

Code	Title	Hours
BIOE 5010	Cell and Molecular Biology for Bioengineers (Fall)	3
BIOE 5011	Systems Physiology for Bioengineers (Spring)	3
BIOE 5020	Analytics and Machine Learning in Bioengineering (Fall) ¹	3
BIOE 5021	Numerical Methods for Engineering Analysis (Spring)	3
BIOE 5420	Special Topics in Bioengineering (Stem Cell and Regenerative Medicine (Fall))	1-6
BIOE 5420	Special Topics in Bioengineering (Graduate Biodesign (Fall))	1-6

¹ Required for BS/MS students. Students can choose to take BIOE 5010 Cell and Molecular Biology for Bioengineers or BIOE 5011 Systems Physiology for Bioengineers.

Approved Non-Bioengineering Technical Electives

Code	Title	Hours
BIOL 3832	General Genetics	3
BIOL 3244	Human Anatomy	5
BIOL 3611	General Cell Biology	3
BIOL 3763	Biostatistics	4
BIOL 4644	Advanced Human Anatomy Laboratory	2
BIOL 5024	Introduction to Biotechnology	3
CHEM 3810	Biochemistry	4
CHEM 3421	Organic Chemistry II	4
CHEM 4810	General Biochemistry I	3
CSCI 3412	Algorithms	3
CSCI 3508	Introduction to Software Engineering	3
CSCI 4287	Embedded Systems Programming	3
ELEC 3030	Electric Circuits and Systems	3
MATH 4650	Numerical Analysis I	3
MECH 4020	Biomechanics	3
MECH 4025	Advanced Biomechanics	3
MECH 4175	Finite Element Analysis in Machine Design	3

To review the Degree Map for this program, please visit our website (<https://www.ucdenver.edu/student/advising/undergraduate/degree-maps/cedc/>).