

# BIOMEDICAL ENGINEERING, B.S.

The Saint Louis University School of Science and Engineering's Bachelor of Science in Biomedical Engineering (BME) focuses on the principles of both engineering and medicine.

The flexibility of our biomedical engineering program means it can accommodate students with a wide variety of interests. Students majoring in biomedical engineering at SLU participate in several academic programs across campus, including the Medical Scholars Program and the University Honors Program.

## Program Highlights

- As a student in the biomedical engineering program at SLU, you will be challenged to integrate your knowledge of the biological and physical sciences with the engineering skills you are developing by participating in hands-on projects inside and outside the classroom.
- You will graduate prepared for many careers in the health care industry, ranging from fundamental research in science and engineering to the direct application of your knowledge to improve health and the overall quality of life for humanity.
- Biomedical engineering majors at SLU can complete certificates, minors or second majors in various disciplines ranging from the liberal arts or science to business or technology.

The program also offers a minor for students interested in developing a focused study within biomedical engineering.

## Curriculum Overview

SLU has developed an innovative, future-focused biomedical engineering program that incorporates the latest trends in the industry to address the current and future needs of the profession and our society. Our B.S. degree in biomedical engineering is designed with three tracks to accommodate our students' different career paths after graduation: pre-health, graduate school and industry. Biomedical engineering courses and laboratory experiences at SLU provide a broad fundamental preparation for any of these paths.

The program is designed to provide a biomedical engineering focus in all core engineering classes, informed by research, into the student experience from the very beginning. The major also offers considerable flexibility, allowing for electives within and outside the program.

## Fieldwork and Research Opportunities

Many laboratory experiences coincide with courses in the basic sciences and engineering.

Each biomedical engineering student at SLU completes a senior capstone design project, a hands-on experience. This year-long project may be explored as an individual, but the projects most often involve groups of students from biomedical engineering, other engineering or computer science departments, biological or medical departments or engineers from corporations. The capstone course is designed to fully embed the student in a project that will challenge even the exceptional student to integrate their previous training and develop their abilities as an engineer.

SLU's well-equipped laboratories emphasize measurement techniques and experimental methods. Each biomedical engineering student's

sequence of courses will vary according to credits taken in high school, ability level, individual preference and career goals. In addition, all students in the biomedical engineering program are exposed to concepts of entrepreneurship and an entrepreneurial mindset through the curriculum and extracurricular opportunities.

The flexibility available within the major offers students an increased opportunity to experience research. More than 25% of our undergraduate student population participates in an organized research experience within the program.

## Careers

There are a variety of career paths to choose from as a biomedical engineer, including industrial or consulting positions; graduate school; and professional schools such as medicine, veterinary medicine or business administration. SLU's curriculum allows BME students to specialize in and explore the biomedical engineering program while still providing a solid background in biological/physical sciences, mathematics and basic engineering.

## Admission Requirements

### Begin Your Application (<http://www.slu.edu/apply.php>)

Saint Louis University also accepts the Common Application.

### Freshman

All applications are thoroughly reviewed with the highest degree of individual care and consideration to all credentials that are submitted. Solid academic performance in college preparatory coursework is a primary concern in reviewing a freshman applicant's file.

To be considered for admission to any Saint Louis University undergraduate program, applicants must be graduating from an accredited high school, have an acceptable HiSET exam score or take the General Education Development (GED) test.

### Transfer

Applicants must be a graduate of an accredited high school or have an acceptable score on the GED.

Students who have attempted fewer than 24 semester credits (or 30 quarter credits) of college credit must follow the above freshmen admission requirements. Students who have completed 24 or more semester credits (or 30 quarter credits) of college credit must submit transcripts from all previously attended college(s).

In reviewing a transfer applicant's file, the Office of Admission holistically examines the student's academic performance in college-level coursework as an indicator of the student's ability to meet the academic rigors of Saint Louis University. Where applicable, transfer students will be evaluated on any courses outlined in the continuation standards of their preferred major.

## International Applicants

All admission policies and requirements for domestic students apply to international students along with the following:

- Demonstrate English Language Proficiency (<https://catalog.slu.edu/academic-policies/office-admission/undergraduate/english-language-proficiency/>)
- Proof of financial support must include:

- A letter of financial support from the person(s) or sponsoring agency funding the time at Saint Louis University
- A letter from the sponsor's bank verifying that the funds are available and will be so for the duration of study at the University
- Academic records, in English translation, of students who have undertaken postsecondary studies outside the United States must include the courses taken and/or lectures attended, practical laboratory work, the maximum and minimum grades attainable, the grades earned or the results of all end-of-term examinations, and any honors or degrees received. WES and ECE transcripts are accepted.

## Additional Admission Requirements

In addition to the general admission and matriculation requirements of the University, applicants to SLU's engineering programs must meet the following requirements:

- **GPA:** Minimum cumulative 3.00 high school GPA for freshmen applicants and 2.70 college GPA for transfer applicants.
- **Coursework:** Fifteen total units of high school work are required: three or four units of English; four or more units of mathematics, including algebra I and II, geometry and precalculus (Algebra II with Trigonometry is not sufficient). Students should be prepared to start the first semester of freshmen year in Calculus I or higher; three or four units of science, including general science, introduction to physical science, earth science, biology, physics or chemistry; two or three units of social sciences including history, psychology or sociology; and three units of electives.

Admission to the School of Science and Engineering's degree programs is based on a combination of secondary school grades, college admission test scores, co-curricular activities and attempted college coursework, as well as other indicators of the applicant's ability, career focus and character. This process respects the non-discrimination policy of the University and is designed to select a qualified, competent and diverse student body with high standards of scholarship and character, consistent with the mission of the University.

## Tuition

Tuition	Cost Per Year
Undergraduate Tuition	\$52,260

Additional charges may apply. Other resources are listed below:

Net Price Calculator (<https://www.slu.edu/financial-aid/tuition-and-costs/calculator.php>)

Information on Tuition and Fees (<https://catalog.slu.edu/academic-policies/student-financial-services/tuition/>)

Miscellaneous Fees (<https://catalog.slu.edu/academic-policies/student-financial-services/fees/>)

Information on Summer Tuition (<https://catalog.slu.edu/academic-policies/student-financial-services/tuition-summer/>)

## Scholarships and Financial Aid

There are two principal ways to help finance a Saint Louis University education:

- **Scholarships:** Scholarships are awarded based on academic achievement, service, leadership and financial need.

- **Financial Aid:** Financial aid is provided through grants and loans, some of which require repayment.

Saint Louis University makes every effort to keep our education affordable. In fiscal year 2022, 99% of first-time freshmen and 90% of all students received financial aid (<https://www.slu.edu/financial-aid/>) and students received more than \$445 million in aid University-wide.

For priority consideration for merit-based scholarships, apply for admission by December 1 and complete a Free Application for Federal Student Aid (FAFSA) by March 1.

For information on other scholarships and financial aid, visit [www.slu.edu/financial-aid](http://www.slu.edu/financial-aid) (<https://www.slu.edu/financial-aid/>).

## Accreditation

The aerospace engineering, biomedical engineering, civil engineering, computer engineering, electrical engineering, and mechanical engineering undergraduate curricula are accredited by the Engineering Accreditation Commission of ABET, [www.abet.org](http://www.abet.org) (<https://www.abet.org>).

Enrollment and Graduation Data for Biomedical Engineering ([https://www.slu.edu/science-and-engineering/\\_pdfs/2018-biomedical-engineering-enrollment-and-graduation-data.pdf](https://www.slu.edu/science-and-engineering/_pdfs/2018-biomedical-engineering-enrollment-and-graduation-data.pdf))

## Learning Outcomes

SLU's undergraduate biomedical engineering program is accredited by the Engineering Accreditation Commission of ABET (<http://www.abet.org>) (<http://www.abet.org/>).

## Program Educational Objectives

The undergraduate program is designed to meet the following specific objectives in order to fulfill the programmatic and institutional missions.

- Graduates will have established themselves as practicing engineers in biomedical engineering and health-related positions in industry, government and academia.
- Graduates will have acquired advanced degrees or be engaged in advanced study in biomedical engineering or other fields related to their long-term career goals.
- Graduates will attain a major milestone in their career development within the first five to seven years.

## Student Outcomes

Graduates of the biomedical engineering program at Saint Louis University will demonstrate an ability to:

- Identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics
- 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
- Communicate effectively with a range of audiences
- 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
- Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives

- Develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusions
- Acquire and apply new knowledge as needed, using appropriate learning strategies

## Additional Experience

Additionally, our graduates will have experience in:

- Applying principles of engineering, biology, human physiology, chemistry, calculus-based physics, mathematics (through differential equations) and statistics
- Solving bio/biomedical engineering problems, including those associated with the interaction between living and non-living systems
- Analyzing, modeling, designing, and realizing bio/biomedical engineering devices, systems, components or processes
- Making measurements on and interpreting data from living systems

## Requirements

Unless otherwise stated, all biomedical engineering courses have prerequisites that require a “C-” or better. Any waiver of a specified prerequisite for a course must be approved by the biomedical engineering faculty member offering that course.

Code	Title	Credits
<b>University Undergraduate Core (<a href="https://catalog.slu.edu/academic-policies/academic-policies-procedures/university-core/">https://catalog.slu.edu/academic-policies/academic-policies-procedures/university-core/</a>)</b>		
<b>32-35</b>		

### Major Requirements

#### Basic Science and Mathematics

CHEM 1110 & CHEM 1115	General Chemistry 1 and General Chemistry 1 Laboratory	4
CHEM 1120 & CHEM 1125	General Chemistry 2 and General Chemistry 2 Laboratory	4
BIOL 1240 & BIOL 1245	General Biology: Information Flow and Evolution and Principles of Biology I Laboratory	4
PHYS 1610 & PHYS 1620	University Physics I and University Physics I Laboratory	4
PHYS 1630 & PHYS 1640	University Physics II and University Physics II Laboratory	4
MATH 1510	Calculus I	4
MATH 1520	Calculus II	4
MATH 2530	Calculus III	4
MATH 3550	Differential Equations	3
STAT 3850	Foundation of Statistics	3

#### Basic Engineering

MENG 1011	Prototyping	1
SE 1700	Engineering Fundamentals	2
SE 1701	Engineering Fundamentals Studio	1
ECE 2001 & ECE 2002	Introduction to Electrical Engineering and Electrical Engineering Lab	4

#### Biomedical Engineering Foundation

BME 2000	Biomedical Engineering Computing	3
BME 2200	Applied Physiology for Engineers	3
BME 3100	Signals	3
BME 3200	Mechanics	3
BME 3300	Transport Fundamentals	3
BME 3400	Materials Science	3

BME 3840	Junior Lab	1
BME 3150	Biomedical Instrumentation	3
BME 4950	Senior Project I	3
BME 4960	Senior Project II	3

#### Advanced Biomedical Engineering <sup>1</sup>

Select six of the following (at least three from the Advanced BME Elective designated by \*\*) 18

BME 4100	BioData Processing and Machine Learning **
BME 4130	Medical Imaging **
BME 4150	Brain Computer Interface
BME 4200	Biomechanics **
BME 4210	Human Movement Biomechanics
BME 4300	Biotransport
BME 4320	Drug Delivery
BME 4400	Biomaterials **
BME 4410	Tissue Engineering
BME 4430	Regenerative Engineering
BME 4600	Quantitative Physiology I **
BME 4650	Quantitative Physiology II
BME 4700	Biomedical Engineering Innovation and Entrepreneurship **
BME 4980	Independent Research

#### BME-Related General Electives

Select 9 credits <sup>2</sup> 9

**Total Credits 123**

<sup>1</sup> Students are required to choose at least three courses from the approved advanced biomedical engineering elective core list and then have the ability to select up to three other advanced biomedical engineering electives.

<sup>2</sup> Biomedical engineering-related general electives should be selected in accordance with the student's long-term educational and career goals. Often, students use these credits for advanced work in math, science, and engineering. However, students may also select courses designed to broaden their education in areas such as liberal arts or business. In all cases the permission of the academic advisor and program coordinator is required. Under no circumstances can prerequisite courses be used as general electives, e.g., Pre-Calculus (MATH 1400 Pre-Calculus (3 cr)) or The Process of Composition (ENGL 1500 The Process of Composition (3 cr)).

## Non-Course Requirements

All Science and Engineering B.A. and B.S. students must complete an exit interview/survey near the end of their bachelor's program.

### Continuation Standards

- Students must maintain a minimum 2.00 GPA.

## Roadmap

Roadmaps are recommended semester-by-semester plans of study for programs and assume full-time enrollment unless otherwise noted.

Courses and milestones designated as critical (marked with !) must be completed in the semester listed to ensure a timely graduation. Transfer credit may change the roadmap.

This roadmap should not be used in the place of regular academic advising appointments. All students are encouraged to meet with their advisor/mentor each semester. Requirements, course availability and sequencing are subject to change.

Course	Title	Credits
<b>Year One</b>		
<b>Fall</b>		
SE 1700	Engineering Fundamentals	2
SE 1701	Engineering Fundamentals Studio	1
BIOL 1240 & BIOL 1245	General Biology: Information Flow and Evolution and Principles of Biology I Laboratory	4
! CHEM 1110 & CHEM 1115	General Chemistry 1 and General Chemistry 1 Laboratory	4
CORE 1500	Cura Personalis 1: Self in Community	1
MATH 1510	Calculus I	4
<b>Credits</b>		<b>16</b>
<b>Spring</b>		
CHEM 1120 & CHEM 1125	General Chemistry 2 and General Chemistry 2 Laboratory	4
MATH 1520	Calculus II	4
! PHYS 1610 & PHYS 1620	University Physics I and University Physics I Laboratory	4
CORE 1900	Eloquentia Perfecta 1: Written and Visual Communication	3
CORE 2500	Cura Personalis 2: Self in Contemplation	0
<b>Credits</b>		<b>15</b>
<b>Year Two</b>		
<b>Fall</b>		
BME 2000	Biomedical Engineering Computing	3
BME 3200	Mechanics	3
MATH 2530	Calculus III	4
PHYS 1630 & PHYS 1640	University Physics II and University Physics II Laboratory	4
CMM 1200	Public Speaking (CORE 1200 Eloquentia Perfecta: Oral and Visual Communication)	3
<b>Credits</b>		<b>17</b>
<b>Spring</b>		
BME 2200	Applied Physiology for Engineers	3
BME 3400	Materials Science	3
ECE 2001 & ECE 2002	Introduction to Electrical Engineering and Electrical Engineering Lab	4
MENG 1011	Prototyping	1
MATH 3550	Differential Equations	3
<b>Credits</b>		<b>14</b>
<b>Year Three</b>		
<b>Fall</b>		
BME 3100	Signals	3
STAT 3850	Foundation of Statistics	3
BME 3300	Transport Fundamentals	3
Advanced BME Elective		3

CORE 3400	Ways of Thinking: Aesthetics, History, and Culture	3
<b>Credits</b>		<b>15</b>
<b>Spring</b>		
BME 3840	Junior Lab	1
BME 3150	Biomedical Instrumentation	3
CORE 1700	Ultimate Questions: Philosophy	3
BME Related Elective		3
Advanced BME Elective		3
Advanced BME Elective		3
<b>Credits</b>		<b>16</b>
<b>Year Four</b>		
<b>Fall</b>		
BME 4950	Senior Project I	3
Advanced BME Elective		3
Advanced BME Elective		3
BME Related Elective		3
CORE 1600	Ultimate Questions: Theology	3
<b>Credits</b>		<b>15</b>
<b>Spring</b>		
BME 4960	Senior Project II	3
Advanced BME Elective		3
CORE 3600	Ways of Thinking: Social and Behavioral Sciences	3
Undergraduate Core Elective		3
BME-Related Elective		3
! Exit Interview/Survey		
<b>Credits</b>		<b>15</b>
<b>Total Credits</b>		<b>123</b>