

BIOMEDICAL ENGINEERING, B.S.

The biomedical engineering program at Saint Louis University's Parks College of Engineering, Aviation and Technology originated in 1997. The biomedical engineering (BME) undergraduate program prepares students for careers ranging from fundamental engineering research to the application of engineering principles to the solution of biomedical design problems.

The BME degree combines Saint Louis University's strengths in medicine and life sciences with engineering. Students learn to apply science and engineering principles to biological and medical sciences. Students also discover opportunities for collaborative research in areas such as biomechanics and orthopedics, tissue engineering, kinetics and metabolism, neuroengineering, medical robotics and medical imaging.

Curriculum Overview

The B.S. degree in biomedical engineering is designed with three tracks to accommodate the different career paths of graduates.

The curriculum leading to the B.S. degree offers considerable flexibility, allowing time for electives within and outside the department. The curriculum is designed for students whose career plans include graduate school, industry or professional schools (medicine, law or business).

The courses and laboratory experiences provide a broad fundamental preparation for any of these career paths. The program is designed with an emphasis on providing a BME focus in all core engineering classes, informed by research, into the students experience from the very beginning.

Because of the flexibility in our degree, our undergraduates participate in a number of academic programs across campus, including the Medical Scholars Program and the University Honors Program. BME majors can also complete certificates, minors or second majors in a variety of 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 the field of BME.

Fieldwork and Research Opportunities

Many laboratory experiences coincide with courses such as in the basic science and engineering courses. Each student completes a senior 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. 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 entrepreneurship and the entrepreneurial mindset through the curriculum and extracurricular opportunities.

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 to develop their abilities as an engineer.

The flexibility available within the major offers students increased opportunity to experience research. More than 25 percent of our undergraduate student population take part in an organized research experience within the department

Careers

As a biomedical engineer, there are a variety of career paths to choose from, including industrial or consulting positions; graduate school; and professional schools such as medicine, veterinary medicine or business administration. The curriculum allows 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

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 course work is a primary concern in reviewing a freshman applicant's file. College admission test scores (ACT or SAT) are used as an additional indicator of the student's ability to meet the academic rigors of Saint Louis University and are used as qualifiers for certain University scholarship programs. To be considered for admission to any Saint Louis University undergraduate program, the applicant must be graduating from an accredited high school or have an acceptable score on 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. An official high school transcript and official test scores are required only of those students who have attempted fewer than 24 transferable semester credits (or 30 quarter credits) of college credit. Those having completed 24 or more of college credit need only submit a transcript from 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.

International Applicants

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

- Demonstrate English Language Proficiency (<http://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, Parks College engineering programs have the following additional requirements:

- GPA: Minimum cumulative 3.00 high school GPA for freshmen applicants and 2.70 college GPA for transfer applicants.
- ACT/SAT: ACT composite score of 24 or higher, or SAT composite score of 1160 or higher. ACT sub scores minimums of 22 in English, 24 in Mathematics, 22 in Reading Comprehension and 22 in Scientific Reasoning, or SAT Math sub score of 620.
- 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 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 requirements to Parks College of Engineering, Aviation and Technology degree programs are based on a combination of secondary school grades, college admission test scores, co-curricular activities and attempted college course work, 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.

Scholarships and Financial Aid

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

- Scholarships: awarded based on academic achievement, service, leadership and financial need.
- Financial Aid: provided in the form of grants and loans, some of which require repayment.

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

For information on other scholarships and financial aid, visit the student financial services office online at <http://finaid.slu.edu>.

Accreditation

The Aerospace Engineering, Biomedical Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, Engineering Physics and Mechanical Engineering undergraduate curricula are accredited by the Engineering Accreditation Commission of ABET, www.abet.org (<https://www.abet.org>).

Enrollment and graduation data for biomedical engineering is listed here (<http://www.slu.edu/parks/pdfs/biomedical-engineering-enrollment-and-graduation-data.pdf>)

Learning Outcomes

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

Program Educational Objectives

The undergraduate program is designed to meet the following specific objectives in order to fulfill the departmental 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 BME program at Saint Louis University will demonstrate:

- an ability to apply knowledge of mathematics, science, and engineering;
- an ability to design and conduct experiments, as well as to analyze and interpret data;
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
- an ability to function on multi-disciplinary teams;
- an ability to identify, formulate, and solve engineering problems;
- an understanding of professional and ethical responsibility;
- an ability to communicate effectively;
- the broad education necessary to understand the impact of engineering solutions in a global and societal context;
- a recognition of the need for, and an ability to engage in life-long learning;
- a knowledge of contemporary issues;
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice;
- an understanding of biology and physiology, and the capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve the problems at the interface of engineering and biology;
- an ability to make measurements on and interpret data from living systems, addressing the problems associated with the interaction between living and non-living materials and systems.

Requirements

The Biomedical Engineering curriculum satisfies the Parks College requirements, and includes the flexibility, through electives, to tailor the curriculum for each individual student.

All BME courses with the exception of BME 1000 Introduction to Biomedical Engineering I (1 cr) have prerequisites that require a "C-" or better.

Any waiver of a specified prerequisite for a course must be approved by the BME Faculty member offering that course.

Code	Title	Credits
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	Principles of Biology I and Principles of Biology I Laboratory	4
PHYS 1610 & PHYS 1620	Engineering Physics I and Engineering Physics I Laboratory	4
PHYS 1630 & PHYS 1640	Engineering Physics II and Engineering Physics II Laboratory	4
MATH 1510	Calculus I	4
MATH 1520	Calculus II	4
MATH 2530	Calculus III	4
MATH 3550	Differential Equations	3
MATH 3850	Foundation of Statistics	3
Basic Engineering		
BME 3200	Mechanics	3
ECE 2001 & ECE 2002	Introduction to Electrical Engineering and Electrical Engineering Lab	4
MENG 2011	Engineering Shop Practice	1
ESCI 2300	Thermodynamics	3
Written and Oral Communication		
ENGL 1900	Advanced Strategies Of Rhetoric and Research	3
Liberal Arts		
THEO 1000	Theological Foundations	3
PHIL 2050	Ethics	3
Humanities (p. 3)		3
Cultural Diversity ¹		3
Social & Behavioral Sciences (p. 3)		3
Non-Technical Elective (p. 3)		3
Biomedical Engineering Core		
BME 1000	Introduction to Biomedical Engineering I	1
BME 1010	Introduction to Biomedical Engineering II	1
BME 2000	BME Computing	3
BME 2200	Applied Physiology for Engineers	3
BME 3100	Signals	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		
Select six of the following:		18
BME 4100	Biomedical Signals	
BME 4130	Medical Imaging	
BME 4150	Brain Computer Interface	
BME 4200	Biomechanics	
BME 4210	Human Movement Biomechanics	
BME 4300	Biotransport	
BME 4310	Advanced topics in Biotransport	
BME 4320	Drug Delivery	
BME 4400	Biomaterials	
BME 4410	Tissue Engineering	
BME 4430	Regenerative Engineering	
BME 4500	Numerical Methods in BME	
BME 4600	Quantitative Physiology I	

BME 4650	Quantitative Physiology II	
BME 4980	Independent Research	
BME-Related General Electives		
Select 9 credits ²		9
Total Credits		124

- ¹ Cultural Diversity elective courses must be selected from an approved Arts & Sciences list. See the description of the Parks College core above for more information.
- ² BME-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 Department Chairperson 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)).

Humanities Courses Include

- Fine Arts (excludes applied, studio, and performance courses),
- Literature (ENGL 2020 Introduction to Literary Study (3 cr)-ENGL 2750 Film, Culture and Literature (3 cr), ENGL 3190 Literature of Ridicule and Satire (3 cr)-ENGL 3740 Medicine and Literature (3 cr), ENGL 4130 Literary Theory (3 cr)-ENGL 4890 Special Topics: American Literature & Culture (3 cr)),
- History,
- American Studies, and
- Foreign Languages (excludes English or native language).

Social & Behavioral Sciences Courses Include

- Anthropology,
- Communication (CMM 1000 Human Communication and Culture (3 cr), CMM 2000 Communication Theory (3 cr), CMM 2800 Communication Research (3 cr)),
- Communication Sciences and Disorders (CSDI 1000 Intro to Comm Sci & Disorders (3 cr), CSDI 4700 Clinical Practicum (1 cr)),
- Economics,
- Education (EDSP 4240 Classroom Organization and Management (EC, ECSE, ELEM, SpEd), EDF 3620 Multicultural Issues in the Classroom (3 cr), EDSP 4310 Ed & Psych of the Exp Ind (3 cr)),
- Political Science,
- Public Health,
- Psychology,
- Social Work (SWRK 1000 Introduction to Social Work (3 cr), SWRK 2100 Human Behavior & the Social Environment (3 cr), SWRK 3100 The American Social Welfare System (3 cr), SWRK 3200 Diversity & Anti-Oppression Practice (3 cr)),
- Sociology, and
- Criminology and Criminal Justice.

Non-Technical Elective shall be Chosen from

- Philosophy,
- Theology,

- Humanities, or
- Social & Behavioral Sciences.

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
Year One		
Fall		
BME 1000	Introduction to Biomedical Engineering I	1
BIOL 1240 & BIOL 1245	Principles of Biology I and Principles of Biology I Laboratory	4
! CHEM 1110 & CHEM 1115	General Chemistry 1 and General Chemistry 1 Laboratory	4
ENGL 1900	Advanced Strategies Of Rhetoric and Research	3
MATH 1510	Calculus I	4
	Credits	16
Spring		
BME 1010	Introduction to Biomedical Engineering II	1
CHEM 1120 & CHEM 1125	General Chemistry 2 and General Chemistry 2 Laboratory	4
MATH 1520	Calculus II	4
! PHYS 1610 & PHYS 1620	Engineering Physics I and Engineering Physics I Laboratory	4
	Credits	13
Year Two		
Fall		
BME 2000	BME Computing	3
BME 2200	Applied Physiology for Engineers	3
BME 3200	Mechanics	3
MATH 2530	Calculus III	4
PHYS 1630 & PHYS 1640	Engineering Physics II and Engineering Physics II Laboratory	4
	Credits	17
Spring		
BME 3400	Materials Science	3
ECE 2001 & ECE 2002	Introduction to Electrical Engineering and Electrical Engineering Lab	4
ESCI 2300	Thermodynamics	3
MATH 3550	Differential Equations	3
MENG 2011	Engineering Shop Practice	1

THEO 1000	Theological Foundations	3
	Credits	17
Year Three		
Fall		
BME 3100	Signals	3
STAT 3850	Foundation of Statistics	3
BME 3300	Transport Fundamentals	3
Advanced BME Elective		3
Humanities Elective		3
	Credits	15
Spring		
BME 3840	Junior Lab	1
BME 3150	Biomedical Instrumentation	3
PHIL 2050	Ethics	3
Advanced BME Elective		3
Advanced BME Elective		3
Advanced BME Elective		3
	Credits	16
Year Four		
Fall		
BME 4950	Senior Project I	3
Advanced BME Elective		3
BME Related Elective		3
BME Related Elective		3
Non-Technical Elective		3
	Credits	15
Spring		
BME 4960	Senior Project II	3
Advanced BME Elective		3
Social/Behavioral Science Elective		3
Cultural Diversity Elective		3
BME-Related Elective		3
	Credits	15
	Total Credits	124