BIOMEDICAL ENGINEERING (BS)

Program Description

The BS in Biomedical Engineering program connects engineering coursework with Biology, Chemistry, and Health & Human Performance courses to prepare students to design and create biomedical devices. This major includes the significant design and hands-on aspects of the engineering major, and allows the biomedical engineering student to work alongside mechanical and electrical engineering students in four design courses so that each major complements the others in this integrated experience that prepares students well for a career in engineering. Our program will emphasize the God-given value of each person, and address designing not just cutting edge, expensive equipment, but also lower-cost equipment that can serve broadly, including marginalized communities.

Students majoring in Biomedical Engineering at SPU will be allowed to also double major in General Engineering without any additional degree requirements. The BS in General Engineering degree is accredited by the Engineering Accreditation Commission of ABET (http://www.abet.org/). So, students earning the BS Biomedical Engineering who also select a General Engineering major will graduate with both this new degree and also the ABET-accredited General Engineering degree.

Entering and Completing the Major

In order to earn a degree, you must complete at least one academic major. SPU encourages students to explore various academic paths, so if you change your mind about a major, or want to include an additional program, you are able to do so, as outlined below.

Note that the University encourages you to enter your chosen major(s) as soon as you have determined it and are eligible to join it, especially by the start of your junior year. Students who transfer as juniors and seniors should enter a major within their first two quarters at SPU.

- If this is your first quarter at SPU and you identified a major in this department as your first choice on your application for admission to the University, you have gained entry to the major. To change or add a major, follow these instructions (https://spu.atlassian.net/l/cp/a3th1keb).
- If you are an SPU student with an SPU cumulative GPA of 2.0 or better, follow these instructions (https://spu.atlassian.net/l/cp/a3th1keb) to enter a major in this department.
- The University requires a grade of C- or better in all classes that apply to a major; however, programs may require higher minimum grades in specific courses. You may repeat an SPU course only once for a higher grade.
- To advance in this program, meet with your faculty advisor regularly to discuss your grades, course progression, and other indicators of satisfactory academic progress. If your grades or other factors indicate that you may not be able to successfully complete the major or minor, your faculty advisor can work with you to explore options, which may include choosing a different major.
- You must complete the major requirements that are in effect in the SPU Undergraduate Catalog for the year you enter the major.

Biomedical Engineering (BS)

136 Credits Minimum, Including 64 Upper Division (UD)

Code	Title	Credits
Engineering Requirements		
CSC 1250 & CSC 1260	Introductory Problem Solving and Programming and Structured Programming [1]	5
or CSC 2230	Computer Programming for Engineers	
EE 1502	Electrical and Computer Engineering Fundamentals	1
EE 2726	Electric Circuits I	5
EGR 1501	Computer Aided Design Applications for Engineers	1
EGR 1503	Engineering Tools and Systems	1
EGR 3311	Experimental Methods I	3
EGR 3810	General Engineering Design	5
EGR 4811	Engineering Senior Design I	3
EGR 4812	Engineering Senior Design II	3
EGR 4899	Engineering Capstone and Senior Design	3
EGR 4941	Engineering Professional Experience [2]	1
GS 3001	Internship and Job Search Strategies	1
ME 2891	Statics	4
ME 3310	Mechanics of Materials	4
Section Credits Required		40
Mathematics Requirements		
MAT 1234	Calculus I	5
MAT 1235	Calculus II	5
MAT 2360	Introduction to Statistics for the Sciences	5
MAT 3237	Differential Equations	3
Section Credits Required		18
Science Requirements		
BIO 2202	General Biology II	5
CHM 1211	General Chemistry I	5
or CHM 1310	Survey of General Chemistry	
PHY 1121	Physics for Science and Engineering	5
PHY 1122	Physics for Science and Engineering	5
PHY 1123	Physics for Science and Engineering	5
Section Credits Required		25
Math/Science breadth (take one)		
BIO 3351	General Microbiology	
CHM 1212	General Chemistry II	
CHM 1360	Survey of Biological Chemistry	
MAT 1236	Calculus III	
MAT 2401	Linear Algebra	
PHY 3311	Experimental Methods I	
Section Credits Required		3
Biomedical Engineering Core		
BME 4000	Biomedical Device Design 1	5
BME 4100	Biomedical Device Design 2	5
BME 4500	Ethical issues in Biomedical Technology	3
EGR 3800	Biomedical Engineering I	5
Section Credits Required		18
Biomedical Foundation Courses		

HHP 1301	Wellness and Physical Activity	3
HHP 2128	Functional Anatomy	3
HHP 3580	Exercise Physiology	5
HHP 3570	Biomechanics	5
Section Credits Required		16
Engineering Emphasis		
Computer engineering:		
CSC 2430 & EE 1210 & EE 3760 & EE 3280	Object Oriented Programming and Introduction to Logic System Design and Computer Organization and Assembly Language and Microcontroller System Design	
Electronics		
EE 2728 & EE 3721 & EE 3721L & EE 3722 & EE 3722L	Electric Circuits II - Expanded and Electronics I - Analog Devices and Circuits and Electronics I - Analog Devices and Circuits Lab and Electronics II Analog Electronics and Electronics II Analog Electronics Lab	
Thermofluids		
ME 3500 & ME 3501 & ME 3502 & MAT 1236 & MAT 3238 & EGR 1502	Thermal Science I: Thermodynamics and Thermal Science II: Fluid Mechanics and Thermal Science III: Heat Transfer and Calculus III and Vector Calculus and Machining and Fabricating	
Robotics/Controls EE [3]		
EE 2728 & EE 3410 & MAT 2401 & MAT 1236 & EGR 4450 or EGR 3250	Electric Circuits II - Expanded and Signal and System Analysis and Linear Algebra and Calculus III and Control Systems Design Introduction to Robotics	
Robotics/Controls: ME [3]		
ME 3400 & ME 3430 & EGR 1502 & EGR 4450 or EGR 3250	Dynamics and System Dynamics and Machining and Fabricating and Control Systems Design Introduction to Robotics	
Section Credits Required		16
Total Credits		**136**

1 For clarity, either both CSC 1250 and CSC 1260 are required, or just CSC 2230.

2 An approved tech internship or professional experience must be completed before passing EGR 4941.

3 For clarity, the requirement is for either EGR 3250 OR EGR 4450.

Suggested Course Sequence

Four Year Plan Starting with Calculus

Course	Title	Credits
Freshman		
Variable		
HHP 1301	Wellness and Physical Activity	3
TCOR 1000	The Christian Faith	5
WRI 1000	Academic Inquiry and Writing Seminar	5
	Credits	**13**
Autumn		
EGR 1501	Computer Aided Design Applications for Engineers	1
FYS 1000	First Year Seminar [1]	3
MAT 1234	Calculus I	5
PHY 1121	Physics for Science and Engineering	5
	Credits	**14**
Winter		
EE 1502	Electrical and Computer Engineering Fundamentals	1
MAT 1235	Calculus II	5
PHY 1122	Physics for Science and Engineering	5
	Credits	**11**
Spring		
EGR 1503	Engineering Tools and Systems	1
MAT 1236	Calculus III	5
PHY 1123	Physics for Science and Engineering	5
	Credits	**11**
Sophomore		
Variable		
Common Curriculum (https://catalog.spu.edu/undergraduate/degree-requirements/baccalaureate-degree-requirements/common-curriculum/) and Exploratory Curriculum (https://catalog.spu.edu/undergraduate/degree-requirements/baccalaureate-degree-requirements/exploratory-curriculum/)		
GS 3001	Internship and Job Search Strategies [2]	1
CSC 2230 or CSC 1250 ***and*** CSC 1260	Computer Programming for Engineers [3] or Introductory Problem Solving and Programming ***and*** Structured Programming	5-10
MAT 2200 or MAT 2360	Engineering Probability and Statistics or Introduction to Statistics for the Sciences	3
	Credits	**9-14**
Autumn		
EE 2726	Electric Circuits I	5
HHP 2128	Functional Anatomy	3
MAT 3237	Differential Equations	3
ME 2891	Statics	4
	Credits	**15**
Winter		
EGR 3800 or HHP 3570	Biomedical Engineering I [4] or Biomechanics	5
ME 3310	Mechanics of Materials	4
tech specialty course [3]		5
	Credits	**14**
Spring		
HHP 3580	Exercise Physiology	5
tech specialty course [3]		5
	Credits	**10**
Junior		
Variable		
Common Curriculum (https://catalog.spu.edu/undergraduate/degree-requirements/baccalaureate-degree-requirements/common-curriculum/) and Exploratory Curriculum (https://catalog.spu.edu/undergraduate/degree-requirements/baccalaureate-degree-requirements/exploratory-curriculum/) as needed		
BME 4100	Biomedical Device Design 2 [5]	5
	Credits	**5**
Autumn		
CHM 1310 or CHM 1211	Survey of General Chemistry or General Chemistry I	5
GS 3001	Internship and Job Search Strategies [6]	1
PHY 3311	Experimental Methods I	3
tech specialty course [3]		0-5
	Credits	**9-14**

Winter		
BIO 2202	General Biology II	5
HHP 3570 or EGR 3800	Biomechanics [4, 6] or Biomedical Engineering I	5
tech specialty course [3]		0-5
	Credits	**10-15**
Spring		
BME 4000	Biomedical Device Design 1 [7]	5
BME 4500	Ethical issues in Biomedical Technology [7]	3
EGR 3810	General Engineering Design	5
tech specialty course [0-3]		5
	Credits	**18**
Senior		
Variable		
Common Curriculum (https://catalog.spu.edu/undergraduate/degree-requirements/baccalaureate-degree-requirements/common-curriculum/) and Exploratory Curriculum (https://catalog.spu.edu/undergraduate/degree-requirements/baccalaureate-degree-requirements/exploratory-curriculum/) as needed		
BME 4100	Biomedical Device Design 2 [5, 6]	5
	Credits	**5**
Autumn		
EGR 4811	Engineering Senior Design I	3
EGR 4941	Engineering Professional Experience [8]	1
	Credits	**4**
Winter		
EGR 4812	Engineering Senior Design II	3
	Credits	**3**
Spring		
BME 4000	Biomedical Device Design 1 [6, 7]	5
BME 4500	Ethical issues in Biomedical Technology [6, 7]	3
EGR 4899	Engineering Capstone and Senior Design	3
	Credits	**11**
	Total Credits	**162-177**

1. Engineering majors should take a FYS 1000 First Year Seminar taught by an engineering faculty member, if one is available.
2. Or Fall of junior year.
3. Depends on the tech specialty selected, see the Requirements (p. 1) page and discuss with faculty advisor.
4. EGR 3800 offered alternate years. If not offered, then take HHP 3570.
5. May be spread over multiple quarters.
6. If not already completed.
7. Offered alternate years.
8. Must be taken AFTER completing or WHILE pursuing an approved internship or an approved certification.

Code	Title	Credits
Common Curriculum		
TCOR 2000	Christian Scripture	5
TCOR 3100	Christian Theology	5
UCOR 2100	World History, Faith, and Reconciliation	5
UCOR 3000	Faith, Philosophy, and Science	5
Exploratory Curriculum		
with DTA or AA see Advisor		
Ways of Knowing in the Arts (https://catalog.spu.edu/undergraduate/degree-requirements/baccalaureate-degree-requirements/exploratory-curriculum/#wkatext)		20
Cultural Understanding and Engagement (https://catalog.spu.edu/undergraduate/degree-requirements/baccalaureate-degree-requirements/exploratory-curriculum/#wetext)		
Ways of Knowing in the Social Sciences (https://catalog.spu.edu/undergraduate/degree-requirements/baccalaureate-degree-requirements/exploratory-curriculum/#wksstext)		
Ways of Knowing in the Humanities (https://catalog.spu.edu/undergraduate/degree-requirements/baccalaureate-degree-requirements/exploratory-curriculum/#wkhtext)		

Two Year Plan for a Transfer Student with or without a DTA

See below for the pre-requisite courses required to complete the degree in two years. It is fine to transfer to SPU without having completed these courses, but it will likely result in requiring more than two years at SPU.

Note also that without a DTA, it will depend on how many of the General Education Courses (Common Curriculum (https://catalog.spu.edu/undergraduate/degree-requirements/baccalaureate-degree-requirements/common-curriculum/), Exploratory Curriculum (https://catalog.spu.edu/undergraduate/degree-requirements/baccalaureate-degree-requirements/exploratory-curriculum/), etc (https://catalog.spu.edu/undergraduate/degree-requirements/baccalaureate-degree-requirements/graduation-requirements-policies/).) are completed before transferring as to whether or not the degree can be completed in two years.

Check the quarter, day and time in the current schedule as course offerings may change. Pay close attention to the pre-requisites of the courses.

Course	Title	Credits
First Year		
Variable		
Common Curriculum (https://catalog.spu.edu/undergraduate/degree-requirements/baccalaureate-degree-requirements/common-curriculum/) and Exploratory Curriculum (https://catalog.spu.edu/undergraduate/degree-requirements/baccalaureate-degree-requirements/exploratory-curriculum/) as needed [1]		5-8
	Credits	**5-8**
Autumn		
EE 2502 or EE 2726	Selected Circuits Topics for Transfer Students ((as needed)) or Electric Circuits I	2-5
GS 3001	Internship and Job Search Strategies	1
HHP 1301	Wellness and Physical Activity	3
HHP 2128	Functional Anatomy	3
PHY 3311	Experimental Methods I	3
tech specialty course [2]		5
	Credits	**17-20**
Winter		
EGR 3800 or HHP 3570	Biomedical Engineering I [3] or Biomechanics	5
tech specialty course [2]		5
	Credits	**10**
Spring		
BME 4000 or HHP 3580	Biomedical Device Design 1 [4] or Exercise Physiology	5
BME 4500	Ethical issues in Biomedical Technology [5]	3
EGR 3810	General Engineering Design	5
tech specialty course [2]		5
	Credits	**18**

Second Year		
Variable		
Common Curriculum (https://catalog.spu.edu/undergraduate/degree-requirements/baccalaureate-degree-requirements/common-curriculum/) and Exploratory Curriculum (https://catalog.spu.edu/undergraduate/degree-requirements/baccalaureate-degree-requirements/exploratory-curriculum/) as needed [1]		5-15
BME 4100	Biomedical Device Design 2 [6]	5
	Credits	**10-20**
Autumn		
EGR 4811	Engineering Senior Design I	3
EGR 4941	Engineering Professional Experience [7]	1
tech specialty course [2]		0-5
	Credits	**4-9**
Winter		
EGR 4812	Engineering Senior Design II	3
HHP 3570 or EGR 3800	Biomechanics [8] or Biomedical Engineering I	5
tech specialty course [2]		0-5
	Credits	**8-13**
Spring		
EE 4899	Electrical Engineering Capstone and Senior Design	3
BME 4500	Ethical issues in Biomedical Technology [9]	3
HHP 3580 or BME 4000	Exercise Physiology [8] or Biomedical Device Design 1	5
	Credits	**11**
	Total Credits	**83-109**

1. Spread between first and second year.
2. Specific course depends on technical specialty pathway. See Degree Requirements.
3. EGR 3800 offered alternate years. Take HHP 3570 if EGR 3800 not offered.
4. BME 4000 offered alternate years. Take HHP 3580 if BME 4000 not offered.
5. Offered alt years.
6. The credits for this course can possibly be spread over multiple quarters.
7. Must be taken AFTER completing or WHILE pursuing an approved internship or an approved certification.
8. Take whichever course is not yet completed.
9. If not already completed. Offered alt years.

Prerequisites for the Two Year Plan

The following courses must be completed before coming to SPU in order to finish at SPU in two years, plus potentially an additional quarter. It is ok to transfer to SPU before completing all of the courses, but it will likely take longer than two years at SPU.

Code	Title	Credits
Mechanical Engineering courses equivalent to SPU's:		
EGR 1501	Computer Aided Design Applications for Engineers	
ME 2891	Statics	
ME 3310	Mechanics of Materials	
Calculus Equivalent to SPU's		
MAT 1234	Calculus I	
MAT 1235	Calculus II	
Programming Equivalent to SPU's (choose one option) [1]		
CSC 2230	Computer Programming for Engineers [1]	
or CSC 1250 & CSC 1260	Introductory Problem Solving and Programming and Structured Programming	
A Circuits I Class with Lab [2]		
Additional Math Equivalents to SPU's		
MAT 2360	Introduction to Statistics for the Sciences	
MAT 2401	Linear Algebra [3]	
MAT 3237	Differential Equations	
Physics Equivalent to SPU's		
PHY 1121	Physics for Science and Engineering	
PHY 1122	Physics for Science and Engineering	
PHY 1123	Physics for Science and Engineering	
Chemistry Equivalent to SPU's		
CHM 1310 or CHM 1211	Survey of General Chemistry (with lab) General Chemistry I	
Biology Equivalent to SPU's		
BIO 2202	General Biology II	
Math/Science breadth course		
A course that satisfies the Math/Science Breadth requirement [4]		

1. Some pathways require two quarters of programming in the same language, one course of which includes Data Structures.
2. Students will take EE 2502 Selected Circuits Topics for Transfer Students at SPU to supplement any content need to reach equivalency to SPU's Circuits 1 course.
3. Required only for some pathways within SPU's BME major.
4. See the Math/Science breadth category under the Degree Requirements.