BIOLOGICAL ENGINEERING, B.S.

Begin Campus: Any Penn State Campus

End Campus: University Park

Degree Requirements
For the Bachelor of Science degree in Biological Engineering, a minimum of 129 credits is required:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education</td>
<td>45</td>
</tr>
<tr>
<td>Requirements for the Major</td>
<td>110-111</td>
</tr>
</tbody>
</table>

27 of the 45 credits for General Education are included in the Requirements for the Major. This includes: 9 credits of GN courses; 6 credits of GQ courses; 3 credits of GS courses; 9 credits of GWS courses.

General Education
Connecting career and curiosity, the General Education curriculum provides the opportunity for students to acquire transferable skills necessary to be successful in the future and to thrive while living in interconnected contexts. General Education aids students in developing intellectual curiosity, a strengthened ability to think, and a deeper sense of aesthetic appreciation. These are requirements for all baccalaureate students and are often partially incorporated into the requirements of a program. For additional information, see the General Education Requirements (https://bulletins.psu.edu/undergraduate/general-education/baccalaureate-degree-general-education-program/) section of the Bulletin and consult your academic adviser.

The keystone symbol appears next to the title of any course that is designated as a General Education course. Program requirements may also satisfy General Education requirements and vary for each program.

Foundations (grade of C or better is required.)
- Quantification (GQ): 6 credits
- Writing and Speaking (GWS): 9 credits

Knowledge Domains
- Arts (GA): 6 credits
- Health and Wellness (GHW): 3 credits
- Humanities (GH): 6 credits
- Social and Behavioral Sciences (GS): 6 credits
- Natural Sciences (GN): 9 credits

Integrative Studies (may also complete a Knowledge Domain requirement)
- Inter-Domain or Approved Linked Courses: 6 credits

University Degree Requirements
First Year Engagement
All students enrolled in a college or the Division of Undergraduate Studies at University Park, and the World Campus are required to take 1 to 3 credits of the First-Year Seminar, as specified by their college First-Year Engagement Plan.

Other Penn State colleges and campuses may require the First-Year Seminar; colleges and campuses that do not require a First-Year Seminar provide students with a first-year engagement experience.

First-year baccalaureate students entering Penn State should consult their academic adviser for these requirements.

Cultures Requirement
6 credits are required and may satisfy other requirements
- United States Cultures: 3 credits
- International Cultures: 3 credits

Writing Across the Curriculum
3 credits required from the college of graduation and likely prescribed as part of major requirements.

Total Minimum Credits
A minimum of 120 degree credits must be earned for a baccalaureate degree. The requirements for some programs may exceed 120 credits. Students should consult with their college or department adviser for information on specific credit requirements.

Quality of Work
Candidates must complete the degree requirements for their major and earn at least a 2.00 grade-point average for all courses completed within their degree program.

Limitations on Source and Time for Credit Acquisition
The college dean or campus chancellor and program faculty may require up to 24 credits of course work in the major to be taken at the location or in the college or program where the degree is earned. Credit used toward degree programs may need to be earned from a particular source or within time constraints (see Senate Policy 83-80 (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#83-80)). For more information, check the Suggested Academic Plan for your intended program.

Requirements for the Major
To graduate, a student enrolled in the major must earn a grade of C or better in each course designated by the major as a C-required course, as specified by Senate Policy 82-44 (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#82-44).

Common Requirements for the Major (All Options)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE 460W</td>
<td>Biological Engineering Design I</td>
<td>2</td>
</tr>
<tr>
<td>BE 466W</td>
<td>Biological Engineering Design II</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 111</td>
<td>Experimental Chemistry I</td>
<td>1</td>
</tr>
<tr>
<td>MATH 231</td>
<td>Calculus of Several Variables</td>
<td>2</td>
</tr>
</tbody>
</table>

Prescribed Courses: Require a grade of C or better

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE 301</td>
<td>Mathematical Modeling of Biological and Physical Systems</td>
<td>3</td>
</tr>
<tr>
<td>BE 302</td>
<td>Heat and Mass Transfer in Biological Systems</td>
<td>4</td>
</tr>
<tr>
<td>BE 304</td>
<td>Engineering Properties of Food and Biological Materials</td>
<td>3</td>
</tr>
<tr>
<td>BE 305</td>
<td>Agricultural Measurements and Control Systems</td>
<td>3</td>
</tr>
<tr>
<td>BE 308</td>
<td>Engineering Elements of Biochemistry and Microbiology</td>
<td>3</td>
</tr>
</tbody>
</table>
BE 391 Communication Skills for BE and BRS Students 2
BE 392 Leadership Skills for BE and BRS Students 2
CHEM 110 Chemical Principles I 3
EDSGN 100 Cornerstone Engineering Design 3
EMCH 211 Statics 3
EMCH 212 Dynamics 3
EMCH 213 Strength of Materials 3
MATH 140 Calculus With Analytic Geometry I 4
MATH 141 Calculus with Analytic Geometry II 4
ME 300 Engineering Thermodynamics I 3
PHYS 211 General Physics: Mechanics 4
PHYS 212 General Physics: Electricity and Magnetism 4

Additional Courses
Select one of the following:
AGBM 101 Economic Principles of Agribusiness Decision Making 3
ECON 102 Introductory Microeconomic Analysis and Policy
ECON 104 Introductory Macroeconomic Analysis and Policy

Additional Courses: Require a grade of C or better
Select one of the following:
CAS 100 Effective Speech
CAS 100A Effective Speech
CAS 100B Effective Speech
CAS 100C Effective Speech
CAS/ENGL 138T Rhetoric and Civic Life II

Select one of the following:
ENGL 15 Rhetoric and Composition
ENGL 30H Honors Rhetoric and Composition
ENGL/CAS 137H Rhetoric and Civic Life I

Select one of the following:
MATH 251 Ordinary and Partial Differential Equations
MATH 250 Ordinary Differential Equations
& MATH 252 and Partial Differential Equations

Select one of the following:
IE 424 Process Quality Engineering
STAT 240 Introduction to Biometry
STAT 250 Introduction to Biostatistics
STAT/MATH 318 Elementary Probability
STAT 401 Experimental Methods
STAT/MATH 418 Introduction to Probability and Stochastic Processes for Engineering

Requirements for the Option
Select an option 36-39

Requirements for the Option
Agricultural Engineering Option (33 credits)

Additional Courses
Select 6 credits in math/basic science 1
Select 6 credits in engineering science/design 1
Select 3 credits in agricultural/biological science 1
Select 6 credits in biological engineering 1
Select 6 credits in technical selection 1,2

Supporting Courses and Related Area: Require a grade of C or better
Select 6 credits from the following:
BE 303 Structural Systems in Agriculture
BE 306 Machines for Agricultural and Biological Processing
BE 307 Principles of Soil and Water Engineering

Food and Biological Processing Engineering Option (33-34 credits)

Prescribed Courses
BE 465 Food and Biological Process Engineering 3
BE 468 Microbiological Engineering 3

Additional Courses
CH 202 Fundamentals of Organic Chemistry I 3
or CHEM 210 Organic Chemistry I

Select one of the following: 3-4
BIOL 230W Biology: Molecules and Cells
BMB 211 Elementary Biochemistry
BMB/MICRB 251 Molecular and Cell Biology I

BME 201 Fundamentals of Cells and Molecules

Additional Courses: Require a grade of C or better
CE 360 Fluid Mechanics 3
or ME 320 Fluid Flow

Supporting Courses and Related Areas
Select 6 credits in emphasis technical elective 1
Select 6 credits in engineering science/design 1
Select 6 credits in technical selection 1,2

Natural Resources Engineering Option (33 credits)

Prescribed Courses
BE 467 Design of Stormwater and Erosion Control Facilities 3

1 Courses to be selected from a list approved by the Agricultural and Biological Engineering faculty. These courses must be chosen so that the engineering design and engineering science requirements for the major are met.
2 Students may apply 3 credits of ROTC to the technical selection category and 3 credits to the GHW category upon completion of the ROTC program.
BE 477  Land-Based Waste Disposal  3
BE 487  Introductory Soil Science  3
SOILS 101  Introductory Soil Science  3

Prescribed Courses: Require a grade of C or better
ASM 309  Measurement & Monitoring of Hydrologic Systems  3
BE 307  Principles of Soil and Water Engineering  3
CE 360  Fluid Mechanics  3

Supporting Courses and Related Areas
Select 6 credits in engineering science/design  1  6
Select 3 credits in biological/environmental sciences  1  3
Select 3 credits in technical selection  1,2  3

1 Courses to be selected from a list approved by the Agricultural and Biological Engineering faculty. These courses must be chosen so that the engineering design and engineering science requirements for the major are met.

2 Students may apply 3 credits of ROTC to the technical selection category and 3 credits to the GHW category upon completion of the ROTC program.