BIOMETICAL ENGINEERING, B.S.

Begin Campus: Any Penn State Campus

End Campus: University Park

Degree Requirements
For the Bachelor of Science degree in Biomedical Engineering, a minimum of 130-131 credits are 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>111-113</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.

Students in residence at the Commonwealth campuses may satisfy the course requirements for semesters 1-3. They should then transfer to University Park to begin studies in their major beginning with semester 4.

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 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). 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.

Common Requirements for the Major (All Options)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME 303</td>
<td>Bio-continuum Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>BME 403</td>
<td>Biomedical Instrumentation Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>BME 429</td>
<td>Biomedical Mechanics and Techniques Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>BME 440</td>
<td>Biomedical Engineering Professional Seminar</td>
<td>1</td>
</tr>
<tr>
<td>BME 450W</td>
<td>Biomedical Senior Design</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 111</td>
<td>Experimental Chemistry I</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 112</td>
<td>Chemical Principles II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 113</td>
<td>Experimental Chemistry II</td>
<td>1</td>
</tr>
<tr>
<td>EMCH 210</td>
<td>Statics and Strength of Materials</td>
<td>5</td>
</tr>
<tr>
<td>MATH 230</td>
<td>Calculus and Vector Analysis</td>
<td>4</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>BME 201</td>
<td>Fundamentals of Cells and Molecules</td>
<td>3</td>
</tr>
<tr>
<td>BME 301</td>
<td>Analysis of Physiological Systems</td>
<td>4</td>
</tr>
<tr>
<td>BME 313</td>
<td>Thermodynamics for Biomedical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>BME 401</td>
<td>Numerical Simulations in Biomedical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>BME 402</td>
<td>Biomedical Instrumentation and Measurements</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 110</td>
<td>Chemical Principles I</td>
<td>3</td>
</tr>
<tr>
<td>CMPSC 200</td>
<td>Programming for Engineers with MATLAB</td>
<td>3</td>
</tr>
<tr>
<td>EDSGN 100</td>
<td>Cornerstone Engineering Design</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 202C</td>
<td>Effective Writing: Technical Writing</td>
<td>3</td>
</tr>
<tr>
<td>MATH 140</td>
<td>Calculus With Analytic Geometry I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 141</td>
<td>Calculus With Analytic Geometry II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 251</td>
<td>Ordinary and Partial Differential Equations</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 211</td>
<td>General Physics: Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 212</td>
<td>General Physics: Electricity and Magnetism</td>
<td>4</td>
</tr>
</tbody>
</table>

### Additional Courses

- Select 1 credit of First-Year Seminar
- ECON 102 Introductory Microeconomic Analysis and Policy
- or ECON 104 Introductory Macroeconomic Analysis and Policy

### Supporting Courses and Related Areas

- Select 1 credit of First-Year Seminar
- Select 3 credits from Related Electives department list

### Requirements for the Option

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 141 &amp; BIOL 142</td>
<td>Introduction to Human Physiology and Physiology Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 141 &amp; BIOL 162</td>
<td>Introduction to Human Physiology and Human Anatomy and Physiology I - Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 141 &amp; BIOL 164</td>
<td>Introduction to Human Physiology and Human Anatomy and Physiology II - Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 240W</td>
<td>Biology: Function and Development of Organisms</td>
<td>3</td>
</tr>
</tbody>
</table>

### Medical Imaging and Devices Option (23 credits)

#### Prescribed Courses

- BME 406 Medical Imaging
- EE 210 Circuits and Devices

#### Additional Courses

- Select 4 credits from the following:
  - CMPEN 270 Digital Design: Theory and Practice
  - CMPEN 271 Introduction to Digital Systems
  - & CMPEN 275 and Digital Design Laboratory
  - EE 310 Electronic Circuit Design I
  - EE 330 Engineering Electromagnetics

### Supporting Courses and Related Areas

- Select 6 credits from the Related Electives department list
- Select 6 credits from Medical Imaging and Device Option department list

### Biomaterials Option (24 credits)

#### Prescribed Courses

- BME 443 Biomedical Materials
- BME 446 Polymers in Biomedical Engineering
- MATSE 201 Introduction to Materials Science

#### Additional Courses

- BME 408 Solid Mechanics of Biological Materials
- or BME 409 Biofluid Mechanics
- or BME 413 Mass Transport in Biological Systems
- CHEM 202 Fundamentals of Organic Chemistry I
- or CHEM 210 Organic Chemistry I

### Supporting Courses and Related Areas

- Select 6 credits from Biomaterials Option department list
- Select 3 credits from Related Electives department list

### Biomechanics Option (24 credits)

#### Prescribed Courses

- BME 408 Solid Mechanics of Biological Materials
- BME 409 Biofluid Mechanics
- EMCH 212 Dynamics
- EMCH 315 Mechanical Response of Engineering Materials
- EMCH 316 Experimental Determination of Mechanical Response of Materials

### Supporting Courses and Related Areas

- Select 9 credits from Biomechanics Option department list
- Select 3 credits from Related Electives department list

### Biochemical Option (24 credits)

#### Prescribed Courses

- BME 408 Biofluid Mechanics
- BME 413 Mass Transport in Biological Systems
- BME 423 Reaction Kinetics of Biological Systems

#### Additional Courses

- CHEM 202 Fundamentals of Organic Chemistry I
- or CHEM 210 Organic Chemistry I

### Supporting Courses and Related Areas

- Select 9 credits from Biochemical Option department list
- Select 3 credits from Related Electives department list