BIOMEDICAL ENGINEERING - BS

The curriculum in biomedical engineering involves the development and application of engineering science and technology for living and medical systems. Although there have been individuals working in biomedical engineering for centuries, today’s modern educational programs are specifically designed to prepare engineers for this challenging field. The curriculum described is broadly based around a basic core of courses developed to prepare students for team involvement with other engineers and with physicians and life scientists in working to solve a wide array of biological and medical problems. Elective courses are included to accommodate individual student specialty interests within the fields of biomechanics, biomaterials, bioinstrumentation, and biomolecular and cellular engineering. Students interested in medical school can meet admission prerequisites through slight modifications and additions to the curriculum.

Program Requirements

The freshman year is identical for degrees in aerospace engineering, biomedical engineering, civil engineering, computer engineering, computer science, electrical engineering, electronic systems, engineering technology, industrial distribution, industrial engineering, manufacturing and mechanical engineering technology, mechanical engineering, multidisciplinary engineering technology, nuclear engineering, ocean engineering, and petroleum engineering. The freshman year is slightly different for chemical engineering in that students take CHEM 101/CHEM 111 or CHEM 107/CHEM 117 and CHEM 102/CHEM 112. Biomedical Engineering also requires a two semester sequence of chemistry courses consisting of CHEM 101/CHEM 111 or CHEM 107/CHEM 117 and CHEM 102/CHEM 112. Students pursuing degrees in biological and agricultural engineering should refer to the specific curriculum for this major. It is recognized that many students will change the sequence and number of courses taken in any semester. Deviations from the prescribed course sequence, however, should be made with care to ensure that prerequisites for all courses are met.

First Year

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>ENGL 104</td>
<td>Composition and Rhetoric</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ENGR 111</td>
<td>Foundations of Engineering</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>MATH 151</td>
<td>Engineering Mathematics</td>
<td>1,2 4</td>
</tr>
<tr>
<td></td>
<td>PHYS 218</td>
<td>Mechanics</td>
<td>4</td>
</tr>
</tbody>
</table>

University Core Curriculum (http://catalog.tamu.edu/undergraduate/general-information/university-core-curriculum) 3

| Semester Credit Hours | 16 |

Spring

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 107</td>
<td>General Chemistry for Engineering Students</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 117</td>
<td>General Chemistry for Engineering Students Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 112</td>
<td>Foundations of Engineering II</td>
<td>2</td>
</tr>
<tr>
<td>MATH 152</td>
<td>Engineering Mathematics II</td>
<td>1,3 4</td>
</tr>
</tbody>
</table>

Program Requirements

Second Year

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>BMEN 101</td>
<td>Introduction to Biomedical Engineering</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>BMEN 207</td>
<td>Computing for Biomedical Engineering</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CHEM 102 &amp; CHEM 112</td>
<td>Fundamentals of Chemistry II and Fundamentals of Chemistry Laboratory II</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>ENGL 203 or ENGL 210</td>
<td>Writing about Literature or Technical and Business Writing</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>MATH 251</td>
<td>Engineering Mathematics III</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>VTPP 434</td>
<td>Physiology for Bioengineers I</td>
<td>4</td>
</tr>
</tbody>
</table>

Spring

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMEN 211</td>
<td>Biomedical Applications of Circuits, Signals and Systems</td>
<td>3</td>
</tr>
<tr>
<td>BMEN 253</td>
<td>Medical Device Design I</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 227</td>
<td>Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 308</td>
<td>Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>VTPP 435</td>
<td>Physiology for Bioengineers II</td>
<td>4</td>
</tr>
</tbody>
</table>

University Core Curriculum (http://catalog.tamu.edu/undergraduate/general-information/university-core-curriculum) 3

| Semester Credit Hours | 18 |

Third Year

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>BMEN 305</td>
<td>Bioinstrumentation</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>BMEN 321</td>
<td>Biomedical Electronics</td>
<td>3</td>
</tr>
</tbody>
</table>

PHYS 208 | Electricity and Optics | 4 |

University Core Curriculum (http://catalog.tamu.edu/undergraduate/general-information/university-core-curriculum) 3

| Semester Credit Hours | 17 |

Total Semester Credit Hours | 33 |

1 A grade of C or better is required.
2 Entering students will be given a math placement exam. Test results will be used in selecting the appropriate starting course which may be at a higher or lower level.
3 Of the 18 hours shown as University Core Curriculum electives, 3 must be from creative arts (for Industrial Distribution this is 3 hours from language, philosophy and culture, see IDIS curriculum for more information), 3 from social and behavioral sciences, 6 from American history, and 6 from government/political science. The required 6 hours from international and cultural diversity may be met by courses satisfying the creative arts, social and behavioral sciences (for Industrial Distribution this is language, philosophy and culture), and American history requirements if they are also on the approved list of international and cultural diversity courses.
4 BMEN and CHEN require 8 hours of freshman chemistry, which may be satisfied by CHEM 101/CHEM 111 or CHEM 107/CHEM 117 and CHEM 102/CHEM 112; Credit by Examination (CBE) for CHEM 101/CHEM 111 or CHEM 107/CHEM 117 plus CHEM 102/CHEM 112; or 8 hours of CBE for CHEM 101/CHEM 111 or CHEM 107/CHEM 117 and CHEM 102/CHEM 112.
<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Semester Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMEN 341</td>
<td>Biofluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>BMEN 343</td>
<td>Introduction to Biomaterials</td>
<td>3</td>
</tr>
<tr>
<td>BMEN 350</td>
<td>Statistics for Biomedical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>University Core Curriculum (<a href="http://catalog.tamu.edu/undergraduate/general-information/university-core-curriculum">http://catalog.tamu.edu/undergraduate/general-information/university-core-curriculum</a>)</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

### Semester Credit Hours
16

#### Spring
- **BMEN 344** Biological Responses to Medical Devices 3
- **BMEN 345** Biomaterials Lab 1
- **BMEN 353** Medical Device Design II 1
- **BMEN 361** Biosolid Mechanics 3
- **BMEN 420** Medical Imaging 3
- Technical elective 3
- High Impact Experience 4
- **BMEN 399** Engineering Professional Development 0

### Semester Credit Hours
14

#### Fourth Year

##### Fall
- **BMEN 453** Analysis and Design Project I 2
- **BMEN 452** Mass and Energy Transfer in Biosystems 3
- **BMEN 465** Biomechanics Experiential Learning Lab 1
- Technical electives 6
- University Core Curriculum (http://catalog.tamu.edu/undergraduate/general-information/university-core-curriculum) 3

### Semester Credit Hours
15

##### Spring
- **BMEN 450** Case Studies 5
- **BMEN 454** Analysis and Design Project II 2
- **ENGR 482/PHIL 482** Ethics and Engineering 5
- Technical electives 6
- University Core Curriculum (http://catalog.tamu.edu/undergraduate/general-information/university-core-curriculum) 3

### Semester Credit Hours
15

### Total Semester Credit Hours
95

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1. A grade of C or better is required.
2. Of the 18 hours shown as University Core Curriculum electives, 3 must be from creative arts, 3 from social and behavioral sciences, 6 from American history, and 6 from government/political science. The required 6 hours from international and cultural diversity may be met by courses satisfying the creative arts, social and behavioral sciences, and American history requirements if they are also on the approved list of international and cultural diversity courses.
3. Technical electives are to be selected from the course list below. Students must select one of the following tracks and take 15 hours from within that track: Bioinstrumentation, Biomaterials, Biomechanics, or Biomolecular & Cellular Engineering. Course selection should be done in consultation with student's advisor and track coordinator.
4. All students are required to complete a high-impact experience in order to graduate. A list of possible high-impact experiences is available in the BMEN advising office.
5. Writing intensive course.
BMEN 457 Orthopedic Biomechanics
BMEN 458 Motion Biomechanics
BMEN 461 Cardiac Mechanics
BMEN 468 Advanced Biomechanics
BMEN 471 Numerical Methods in Biomedical Engineering
MEEN 363 Dynamics and Vibrations
MEEN 368 Solid Mechanics in Mechanical Design
MEEN 440 Bio-inspired Engineering Design
MEEN 441 Design of Mechanical Components and Systems
MEEN 442 Computer Aided Engineering
MEEN 444 Finite Element Analysis in Mechanical Engineering

**Biomedical and Cellular Engineering**

Required courses 6

BMEN 431 Biomolecular Engineering
BMEN 433 Biomolecular and Cellular Engineering Laboratory

Select from the following: 6-9

BMEN 291 Research
or BMEN 481 Research
BMEN 471 Numerical Methods in Biomedical Engineering
or BIOL 3 or Computational Genomics
BMEN 432 Molecular and Cellular Biomechanics

Select up to one course from the following:

BMEN 480 Biomedical Engineering of Tissues
BMEN 486 Biomedical Nanotechnology
BMEN 487 Drug Delivery

Select from the following to apply to any of the tracks above: 0-3

BMEN 404 FDA Good Laboratory and Clinical Practices
BMEN 406 Medical Device Path to Market
BMEN 469 Entrepreneurial Issues in Biomedical Engineering
ENGR 181 Engineering Honors Seminar I
ENGR 281 Engineering Honors Mentoring & Team Building Seminar
ENGR 381 Engineering Honors Leadership & Project Management Seminar
ENGR 385 Problems for Co-Op Students
CHEM 228 Organic Chemistry II
VTPB 410 Cell Mechanisms of Disease
VTPP 401 History of Human and Veterinary Medicine in Europe

400-Level BMEN with department approval
(http://catalog.tamu.edu/undergraduate/course-descriptions/bmen)