BIOMEDICAL ENGINEERING - BS

Department Head: M. McShane

Director of Undergraduate Programs: C. Patrick

Committed to solving the world’s greatest health problems through the exploration of new ideas, integrated research and innovation, the Department of Biomedical Engineering at Texas A&M University is producing the next generation of biomedical engineers in industry and at tier-one research institutions, developing new technologies and new jobs, and achieving revolutionary advancements for the future of health care.

The undergraduate curriculum in biomedical engineering involves the development and application of engineering science and technology for living and medical systems. Based around a basic core of courses, the bachelor’s degree is designed to prepare students for team involvement with other engineers and with physicians and life scientists 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 specialized professional school programs such as medical school can meet admission prerequisites through slight modifications and additions to the curriculum.

The department offers a Bachelor of Science degree and a minor. For more information, including degree requirements and application deadlines, visit http://engineering.tamu.edu/biomedical (http://engineering.tamu.edu/biomedical/).

Program Requirements

The freshman year is identical for degrees in aerospace engineering, architectural engineering, civil engineering, computer engineering, computer science, electrical engineering, electronic systems engineering technology, environmental engineering, industrial distribution, industrial engineering, interdisciplinary engineering, manufacturing and mechanical engineering technology, mechanical engineering, multidisciplinary engineering technology, nuclear engineering, ocean engineering, and petroleum engineering (Note: not all programs listed are offered in Qatar). The freshman year is slightly different for chemical engineering, biomedical engineering and materials science and engineering degrees in that students take CHEM 119 or CHEM 107/CHEM 117 and CHEM 120.

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>Fall</th>
<th>Semester Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>CHEM 107</td>
<td>General Chemistry for Engineering Students 1,4</td>
</tr>
<tr>
<td>CHEM 117</td>
<td>General Chemistry for Engineering Students Laboratory 1,4</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Spring</th>
<th>Semester Credit Hours</th>
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<tbody>
<tr>
<td>ENGR 216/PHYS 216</td>
<td>Experimental Physics and Engineering Lab 2</td>
</tr>
<tr>
<td>MATH 152</td>
<td>Engineering Mathematics II 1</td>
</tr>
<tr>
<td>PHYS 206</td>
<td>Newtonian Mechanics for Engineering and Science 3</td>
</tr>
</tbody>
</table>

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

Select one of the following: 3-4
- CHEM 120 Fundamentals of Chemistry II 1,4

University Core Curriculum (http://catalog.tamu.edu/undergraduate/general-information/university-core-curriculum/) 1,5

<table>
<thead>
<tr>
<th>Semester Credit Hours</th>
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<tbody>
<tr>
<td>15-16</td>
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</table>

Total Semester Credit Hours 31-32

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 21 hours shown as University Core Curriculum electives, 3 must be from creative arts (see AREN curriculum for more information), 3 from social and behavioral sciences (see IDIS curriculum for more information), 3 from language, philosophy and culture (see CVEN, EVEN and PETE curriculum for more information), 6 from American history and 6 from government/political science. The required 3 hours of international and cultural diversity and 3 hours of cultural discourse may be met by courses satisfying the creative arts, social and behavioral sciences, language, philosophy and culture, and American history requirements if they are also on the approved list of international and cultural diversity (http://catalog.tamu.edu/undergraduate/general-information/degree-information/international-cultural-diversity-requirements/) courses and cultural discourse (http://catalog.tamu.edu/undergraduate/general-information/degree-information/cultural-discourse-requirements/) courses.
4. BMEN, CHEN and MSEN require 8 hours of fundamentals of chemistry which are satisfied with CHEM 119 or CHEM 107/CHEM 117 and CHEM 120; Students with an interest in BMEN, CHEN and MSEN can take CHEM 120 second semester freshman year. CHEM 120 will substitute for CHEM 107/CHEM 117.
5. For BS-PETE, allocate 3 hours to core communications course (ENGL 210, COMM 203, COMM 205, or COMM 243) and/or 3 hours to UCC elective. For BS-MEEN, allocate 3 hours to core communications course (ENGL 203, ENGL 210, or COMM 205) and/or 3 hours to UCC elective.
### Second Year

#### Fall
- **BMEN 153** Pathways in Biomedical Engineering 1,6 1
- **BMEN 207** Computing for Biomedical Engineering 1 3
- **ENGR 217/PHYS 217** Experimental Physics and Engineering Lab III - Electricity and Magnetism 2
- **MATH 251** or **MATH 253** Engineering Mathematics III or Engineering Mathematics III 3
- **PHYS 207** Electricity and Magnetism for Engineering and Science 3
- **VTPP 434** Physiology for Bioengineers I 4

**Semester Credit Hours**: 16

#### Spring
- **BMEN 211** Biomedical Applications of Signals and Systems 1,6 3
- **BMEN 253** Medical Device Design I 1 1
- **CHEM 227** Organic Chemistry I 3
- **MATH 308** Differential Equations 3
- **VTPP 435** Physiology for Bioengineers II 3

Select one of the following:
- **COMM 203** Public Speaking 3
- **COMM 205** Communication for Technical Professions 3
- **ENGL 203** Writing about Literature 3
- **ENGL 210** Technical and Professional Writing 3

**Semester Credit Hours**: 16

### Third Year

#### Fall
- **BMEN 305** Bioinstrumentation 1 1
- **BMEN 321** Biomedical Electronics 1 3
- **BMEN 341** Biofluid Mechanics 1 3
- **BMEN 343** Introduction to Biomaterials 1 3
- **BMEN 350** Statistics for Biomedical Engineering 1 3

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

**High Impact Experience**: 3

**BMEN 399** Engineering Professional Development 0

**Semester Credit Hours**: 17

#### Spring
- **BMEN 344** Biological Responses to Medical Devices 1 3
- **BMEN 345** Biomaterials Lab 1 3
- **BMEN 353** Medical Device Design II 1 3
- **BMEN 361** Biosolid Mechanics 1 3
- **BMEN 420** Medical Imaging 1 3

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

**Semester Credit Hours**: 16

### Fourth Year

#### Fall
- **BMEN 452** Mass and Energy Transfer in Biosystems 1 3
- **BMEN 453** Analysis and Design Project I 1 2

**BMEN 465** Biomechanics Experiential Learning Lab 1 1

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

**Technical electives**: 6

**Semester Credit Hours**: 15

#### Spring
- **BMEN 450** Case Studies 1,6 1
- **BMEN 454** Analysis and Design Project II 1 2

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

**Technical electives**: 9

**Semester Credit Hours**: 15

**Total Semester Credit Hours**: 96

6. Writing intensive course.
7. 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.
8. 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 and Cellular Engineering. Course selection should be done in consultation with student’s advisor and track coordinator, may use up to 3 hours of BMEN 491. Please note ACCT 640 is for students pursuing the MSF program.

### Total Program Hours 128

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Semester Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>BMEN 322</td>
<td>Biosignal Analysis</td>
<td>6</td>
</tr>
<tr>
<td>BMEN 401</td>
<td>Principles and Analysis of Biological Control Systems</td>
<td>6-9</td>
</tr>
<tr>
<td>BMEN 402</td>
<td>Biomedical Optics Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>BMEN 422</td>
<td>Bioelectromagnetism</td>
<td>3</td>
</tr>
<tr>
<td>BMEN 425</td>
<td>Biophotonics</td>
<td>3</td>
</tr>
<tr>
<td>BMEN 427</td>
<td>Magnetic Resonance Engineering or ECEN 468 Magnetic Resonance Engineering</td>
<td>3</td>
</tr>
<tr>
<td>BMEN 428</td>
<td>Embedded Systems for Medical</td>
<td>3</td>
</tr>
<tr>
<td>CSCE 461</td>
<td>Applications</td>
<td>3</td>
</tr>
<tr>
<td>BMEN 491</td>
<td>Research</td>
<td>3</td>
</tr>
<tr>
<td>BMEN 448</td>
<td>Healthcare Technology in the Developing World</td>
<td>3</td>
</tr>
<tr>
<td>ECEN 411</td>
<td>Introduction to Magnetic Resonance Imaging and Magnetic Resonance Spectroscopy</td>
<td>3</td>
</tr>
<tr>
<td>ECEN 412</td>
<td>Ultrasound Imaging</td>
<td>3</td>
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<tr>
<td>ECEN 414</td>
<td>Biosensors</td>
<td>3</td>
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<tr>
<td>ECEN 447</td>
<td>Digital Image Processing</td>
<td>3</td>
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</tbody>
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### Bioinstrumentation

**Required courses**

- **BMEN 322** Biosignal Analysis
- **BMEN 401** Principles and Analysis of Biological Control Systems

**Select from the following:**

- **BMEN 402** Biomedical Optics Laboratory
- **BMEN 422** Bioelectromagnetism
- **BMEN 425** Biophotonics
- **BMEN 427** Magnetic Resonance Engineering or ECEN 468 Magnetic Resonance Engineering

**Biomaterials**

- **BMEN 428** Embedded Systems for Medical
- **CSCE 461** Applications
Select from the following: 6-15
- BMEN 480 Biomedical Engineering of Tissues
- BMEN 482 Polymeric Biomaterials
- BMEN 483 Polymeric Biomaterial Synthesis
- BMEN 486 Biomedical Nanotechnology
- BMEN 487 Drug Delivery

Select from the following: 0-9
- BMEN 491 Research
- CHEM 466 Polymer Chemistry
- CHEN 451 Introduction to Polymer Engineering
- MEEN 458 Processing and Characterization of Polymers
- MSEN 410 Materials Processing
- MSEN 420 Polymer Science

**Biomechanics**
Select from the following: 12-15
- BMEN 432 Molecular and Cellular Biomechanics
- BMEN 457 Orthopedic Biomechanics
- BMEN 458 Motion Biomechanics
- BMEN 461 Cardiac Mechanics
- BMEN 463 Soft Tissue Mechanics and Finite Element Methods
- BMEN 471 Numerical Methods in Biomedical Engineering
- BMEN 491 Research
- 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

**Biomolecular and Cellular Engineering**
Required courses 6
- BMEN 431 Biomolecular Engineering
- BMEN 433 Biomolecular and Cellular Engineering Laboratory

Select from the following: 6-9
- BMEN 471 Numerical Methods in Biomedical Engineering
- or BIOL 359 Computational Genomics
- BMEN 432 Molecular and Cellular Biomechanics
- BMEN 480 Biomedical Engineering of Tissues
- BMEN 486 Biomedical Nanotechnology
- BMEN 487 Drug Delivery
- BMEN 491 Research

Select from the following to apply to any of the tracks above: 0-3
- ACCT 640 Accounting Concepts and Procedures I (MSF Students only)
- BMEN 400/ History of Human and Veterinary Medicine
- BMEN 404 FDA Good Laboratory and Clinical Practices
- BMEN 469 Entrepreneurial Pathways in Medical Devices
- CHEM 228 Organic Chemistry II
- ENGR 385 Problems for Co-Op Students
- ENGR 410 Global Engineering Design (International Engineering Certificate only)
- VTPB 410 Cell Mechanisms of Disease

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