

# 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, cellular and molecular bioengineering, computational bioengineering, imaging and photonics, medical devices, regenerative medicine, or sensing and monitoring. 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, data engineering, 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

Fall		Semester Credit Hours
CHEM 107	General Chemistry for Engineering Students <sup>1,4</sup>	3
CHEM 117	General Chemistry for Engineering Students Laboratory <sup>1,4</sup>	1

ENGL 103 or ENGL 104	Introduction to Rhetoric and Composition <sup>1</sup> or Composition and Rhetoric	3
ENGR 102	Engineering Lab I - Computation <sup>1</sup>	2
MATH 151	Engineering Mathematics I <sup>1,2</sup>	4
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> ) <sup>3</sup>		3
<b>Semester Credit Hours</b>		<b>16</b>
<b>Spring</b>		
ENGR 216/ PHYS 216	Experimental Physics and Engineering Lab II - Mechanics <sup>1</sup>	2
MATH 152	Engineering Mathematics II <sup>1</sup>	4
PHYS 206	Newtonian Mechanics for Engineering and Science <sup>1</sup>	3
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> ) <sup>3</sup>		3
Select one of the following:		3-4
CHEM 120	Fundamentals of Chemistry II <sup>1,4</sup>	
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> ) <sup>3,5</sup>		
<b>Semester Credit Hours</b>		<b>15-16</b>
<b>Total Semester Credit Hours</b>		<b>31-32</b>

<sup>1</sup> A grade of C or better is required.

<sup>2</sup> 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.

<sup>3</sup> 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 DAEN and 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.

<sup>4</sup> 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.

<sup>5</sup> 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		Semester Credit Hours
BMEN 201	Professional Development Essentials <sup>1,6</sup>	3
BMEN 253	Discovering Biomedical Engineering Design Thinking <sup>1</sup>	1
ENGR 217/ PHYS 217	Experimental Physics and Engineering Lab III - Electricity and Magnetism <sup>1</sup>	2
MATH 251 or MATH 253	Engineering Mathematics III <sup>1</sup> or Engineering Mathematics III	3
PHYS 207	Electricity and Magnetism for Engineering and Science <sup>1</sup>	3
VTPP 434	Physiology for Bioengineers I <sup>1</sup>	4
<b>Semester Credit Hours</b>		<b>16</b>

**Spring**

BMEN 207	Computing for Biomedical Engineering <sup>1</sup>	3
BMEN 250 or STAT 312	Biostatistics and Data Visualization <sup>1</sup> or Statistics for Biology	3
BMEN 254	Biomedical Engineering Design I <sup>1</sup>	1
MATH 308	Differential Equations <sup>1</sup>	3
VTPP 435	Physiology for Bioengineers II <sup>1</sup>	4
Select one of the following:		3
COMM 203	Public Speaking	
COMM 205	Communication for Technical Professions	
ENGL 203	Writing about Literature	
ENGL 210	Technical and Professional Writing	
<b>Semester Credit Hours</b>		<b>17</b>

**Third Year**

Fall		Semester Credit Hours
BMEN 321	Circuits, Signals, and Systems <sup>1</sup>	3
BMEN 351	Biomedical and Health Data Science <sup>1</sup>	3
BMEN 353	Biomedical Engineering Device Design II <sup>1</sup>	1
BMEN 361	Biomedical Engineering Mechanics <sup>1,6</sup>	3
CHEM 227	Organic Chemistry I <sup>1</sup>	3
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> ) <sup>1,3</sup>		3
High Impact Experience <sup>7</sup>		0
BMEN 399	Engineering Professional Development	
<b>Semester Credit Hours</b>		<b>16</b>

**Spring**

BMEN 311	Imaging Living Systems <sup>1</sup>	3
BMEN 341	Biotransport <sup>1</sup>	3
BMEN 343	Biomedical Engineering Materials <sup>1</sup>	3
BMEN 344	Biological Interactions and Testing <sup>1</sup>	3
BMEN 354	Biomedical Engineering Design III <sup>1</sup>	2
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> ) <sup>3</sup>		3
<b>Semester Credit Hours</b>		<b>17</b>

**Fourth Year**

Fall		Semester Credit Hours
BMEN 453	Analysis and Design Project I <sup>1</sup>	3

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> ) <sup>3</sup>	3
Technical electives <sup>1,8</sup>	9

**Semester Credit Hours****15****Spring**

BMEN 454	Analysis and Design Project II <sup>1</sup>	3
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> ) <sup>3</sup>	6	
Technical electives <sup>1,8</sup>	6	

**Semester Credit Hours****15****Total Semester Credit Hours****96**<sup>6</sup> Writing intensive (W) course.<sup>7</sup> 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.<sup>8</sup> 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, and may use up to 3 hours of BMEN 491. Please note ACCT 640 is for students pursuing the MSF program and ENGR 410 is for students pursuing the International Engineering Certificate.**Total Program Hours 128**

Code	Title	Semester Credit Hours
<b>Biomechanics</b>		
Required courses		6
BMEN 463	Soft Tissue Mechanics and Finite Element Methods <sup>1</sup>	
Select one of the following: <sup>1</sup>		
BMEN 457	Orthopedic Biomechanics (Select one of the following): <sup>1</sup>	
BMEN 458	Motion Biomechanics <sup>1</sup>	
BMEN 461	Cardiac Mechanics <sup>1</sup>	
Select from the following:		6-9
BMEN 432	Molecular and Cellular Biomechanics <sup>1</sup>	
BMEN 457	Orthopedic Biomechanics <sup>1</sup>	
BMEN 458	Motion Biomechanics <sup>1</sup>	
BMEN 461	Cardiac Mechanics <sup>1</sup>	
BMEN 491	Research <sup>1</sup>	
MEEN 363	Dynamics and Vibrations <sup>1</sup>	
MEEN 368	Solid Mechanics in Mechanical Design <sup>1</sup>	
<b>Cellular and Molecular Bioengineering</b>		
Required Courses:		6
BMEN 431	Biomolecular Engineering <sup>1</sup>	
BMEN 432	Molecular and Cellular Biomechanics <sup>1</sup>	
Select from the following:		6-9

BMEN 480	Biomedical Engineering of Tissues <sup>1</sup>	
BMEN 486	Biomedical Nanotechnology <sup>1</sup>	
BMEN 487	Drug Delivery <sup>1</sup>	
BMEN 491	Research <sup>1</sup>	
ECEN 414	Biosensors <sup>1</sup>	

**Computational Bioengineering**

Required courses: 6

BMEN 401	Principles and Analysis of Biological Control Systems <sup>1</sup>	
BMEN 471	Numerical Methods in Biomedical Engineering <sup>1</sup>	

Select from the following: 6-9

BIOL 350	Computational Genomics <sup>1</sup>	
BMEN 463	Soft Tissue Mechanics and Finite Element Methods <sup>1</sup>	
BMEN 491	Research <sup>1</sup>	
MEEN 442	Computer Aided Engineering <sup>1</sup>	
MEEN 444	Finite Element Analysis in Mechanical Engineering <sup>1</sup>	

**Imaging, Sensing, & Digital Health**

Required Course: 3

BMEN 420	Medical Imaging <sup>1</sup>	
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Select from the following: 9-12

BMEN 401	Principles and Analysis of Biological Control Systems <sup>1</sup>	
BMEN 422	Bioelectromagnetism <sup>1</sup>	
BMEN 425	Biophotonics <sup>1</sup>	
BMEN 427	Magnetic Resonance Engineering <sup>1</sup>	
BMEN 428/	Embedded Systems for Medical	
CSCE 461	Applications <sup>1</sup>	
BMEN 491	Research <sup>1</sup>	
ECEN 411	Introduction to Magnetic Resonance Imaging and Magnetic Resonance Spectroscopy <sup>1</sup>	

**Medical Devices**

Required courses: 6

BMEN 404	FDA Good Laboratory and Clinical Practices <sup>1</sup>	
BMEN 469	Entrepreneurial Pathways in Medical Devices <sup>1</sup>	

Select from the following: 6-9

BMEN 491	Research <sup>1</sup>	
MEEN 440	Bio-inspired Engineering Design <sup>1</sup>	
MEEN 441	Design of Mechanical Components and Systems <sup>1</sup>	
MEEN 442	Computer Aided Engineering <sup>1</sup>	

**Regenerative Medicine**

Required courses: 6

BMEN 480	Biomedical Engineering of Tissues <sup>1</sup>	
BMEN 482	Polymeric Biomaterials <sup>1</sup>	
or BMEN 483	Polymeric Biomaterial Synthesis	

Select from the following: 6-9

BMEN 482	Polymeric Biomaterials <sup>1</sup>	
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BMEN 483	Polymeric Biomaterial Synthesis <sup>1</sup>	
BMEN 486	Biomedical Nanotechnology <sup>1</sup>	
BMEN 491	Research <sup>1</sup>	
CHEM 466	Polymer Chemistry <sup>1</sup>	
CHEN 451	Introduction to Polymer Engineering <sup>1</sup>	
MEEN 458	Processing and Characterization of Polymers <sup>1</sup>	
MSEN 410	Materials Processing <sup>1</sup>	
MSEN 420	Polymer Science <sup>1</sup>	

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

ACCT 640	Accounting Concepts and Procedures I (MSF Students only) <sup>1</sup>	
BMEN 400/	History of Human and Veterinary	
VTPP 401	Medicine in Europe <sup>1</sup>	
BMEN 404	FDA Good Laboratory and Clinical Practices <sup>1</sup>	
BMEN 448	Healthcare Technology in the Developing World <sup>1</sup>	
BMEN 469	Entrepreneurial Pathways in Medical Devices <sup>1</sup>	
CHEM 228	Organic Chemistry II <sup>1</sup>	
ENGR 385	Problems for Co-Op Students <sup>1</sup>	
ENGR 410	Global Engineering Design <sup>1,8</sup>	
VTPB 410	Cell Mechanisms of Disease <sup>1</sup>	
400-Level BMEN with department approval	( <a href="http://catalog.tamu.edu/undergraduate/course-descriptions/bmen/">http://catalog.tamu.edu/undergraduate/course-descriptions/bmen/</a> ) <sup>1</sup>	