Biomedical Engineering, Molecular, Cellular, and Tissue Biomechanics (BSBiomedE)

The major objective of this concentration is to provide students with knowledge of the structure and function of biological systems by means of the methods of mechanics. Students will learn skills to apply engineering principles to understand how living systems function at all scales of organization and to translate this understanding to the design of devices and procedures that will improve diagnostic and therapeutic methods in health care.

Biomedical Engineering

The mission of the Department of Biomedical Engineering is to develop clinically translatable solutions for human health by training the next generation of biomedical engineers, cultivating leaders, and nurturing the integration of science, engineering, and medicine in a discovery-centered environment. The main educational objective is to provide a thorough training in the fundamentals of engineering science, design, and biology. The curriculum is designed to provide concepts central to understanding living systems from the molecular and cellular levels to the tissue and organismal levels. The curriculum incorporates principles of vertical integration, leading to the choice of a concentration (biomedical imaging and instrumentation, cellular and biomolecular engineering, computational biomedical engineering, or molecular, cellular, and tissue biomechanics), and culminates in a team capstone design experience. Students are expected to develop an understanding of industrial, research, and clinical biomedical engineering environments; an understanding of regulatory issues and biomedical ethics; the ability to create, identify, formulate, and solve biomedical engineering problems; the ability to design systems to meet needs in medical/life science applications; an understanding of life processes at the molecular, cellular, tissue, and organismal levels; the ability to use instrumentation and to make measurements and interpret data in living systems; and an appreciation of the interdisciplinary nature of biomedical engineering research.

Concentrations

Concentrations allow the student to build on the biomedical engineering curriculum. Students choose coursework in one of four concentrations: biomedical imaging and instrumentation; cellular and biomolecular engineering; computational biomedical engineering; or molecular, cellular and tissue biomechanics. Within some concentrations, career emphases are available for students to focus coursework toward a particular career track. Students have flexibility to take technical elective coursework from more than one career emphasis under the same concentration.

Minors and Certificate Programs

Biomedical engineering students may enrich their education through minors and certificate programs. For a full list please see Minor and Certificate Programs. Common examples of certificates completed by biomedical engineering students are as follows:

Business Foundations Minor. Students who wish to learn about fundamental business concepts and practices may take supplemental coursework that leads to the Business Foundations Minor, awarded by the Red McCombs School of Business. The certificate description is provided in the program's page.

Health Care Reform and Innovation Minor. The Red McCombs School of Business offers this minor to prepare students for the unique challenges and opportunities in the field of healthcare. The minor description is provided in the program's page.

Computational Science and Engineering (CSE) Certificate. This certificate offers the opportunity for in-depth study and research in computational science and engineering, including computational and applied mathematics, numerical simulation, scientific computation, and visualization. The certificate is administered by the Oden Institute for Computational Engineering and Sciences and its description is provided in the program's page.

Programming and Computation Certificate. Students who wish to learn about computer science may take the coursework that leads to the Programming and Computation Certificate, awarded by the Department of Computer Science. The certificate description is provided in the program's page.

Pre-Health Professions Certificate. This certificate provides majors outside of the College of Natural Sciences (CNS) access to the courses required to complete health professions prerequisites. The certificate description is provided in the program's page.

Licensure

Preparation for Health Professions

Students who plan to attend medical or dental school in Texas must complete coursework in addition to that required for the degree to meet professional school admission requirements; those who plan to attend schools outside Texas may need additional coursework. The student is responsible for knowing and meeting these additional requirements, and assistance and information are available in the Health Professions Office in Natural Sciences. Additional information about preparation for health professions is available online.

Preparation for Law

There is no sequential arrangement of courses prescribed for a pre-law program. The Association of American Law Schools puts special emphasis on comprehension and expression in words, critical understanding of the human institutions and values with which the law deals, and analytical power in thinking. Courses relevant to these objectives deal with communication of ideas, logic, mathematics, social sciences, history, philosophy, and the physical sciences. Services for pre-law students are provided to students in all colleges by Liberal Arts Career Services, and to engineering students by the Engineering Career Assistance Center (ECAC). Additional information about preparation for law is available online.

Objectives

Achievement of the program outcomes gives students the foundation for accomplishing the biomedical engineering program educational objectives. A few years after graduation, students are expected to be able to:

- Conduct themselves with exemplary professional ethics and highest integrity
- Demonstrate a quantitative, analytical, and systems approach to problem solving in their professional practice
- Demonstrate a continuous quest for professional excellence and success
- Participate in continuing education to expand their knowledge of contemporary professional issues

- Exhibit effective scientific, technical, communication, and resource management skills in their professional practice

Outcomes

Graduates of the biomedical engineering program are expected to have:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specific needs with consideration of public health, safety, and welfare, as well as global, cultural, societal, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Total Hours Required: 132

Plan of Study

The Plan of Study is a suggested four-year course sequence to support academic planning and serves as a helpful guide. Currently enrolled students should meet with their academic advisor to tailor their course selections and timelines to their individual goals and circumstances.

Course	Title	Hours
Year 1		
Semester 1		
BME 303L	Introduction to Biomedical Engineering Design	3
CH 401	Principles of Chemistry I	4
BIO 311C	Introductory Biology I	3
BIO 206L	Introductory Laboratory Experiments in Biology	2
M 408C	Differential and Integral Calculus	4
First-Year Signature Course (090)		3
	Hours	**19**
Semester 2		
BME 303	Introduction to Computing	3
CH 402	Principles of Chemistry II	4
M 408D	Sequences, Series, and Multivariable Calculus	4
PHY 303K	Engineering Physics I	3
PHY 105M	Laboratory For Physics 302K, 303K, and 317K	1
RHE 306	Rhetoric and Writing	3
	Hours	**18**
Year 2		
Semester 1		
BME 214L	Computational Fundamentals of Biomedical Engineering Design	2
BME 311	Network Analysis in Biomedical Engineering (advisor approval required)	3
CH 328M or CH 320M	Organic Chemistry I or Organic Chemistry I	3
M 427J	Differential Equations with Linear Algebra	4
PHY 303L	Engineering Physics II	3
PHY 105N	Laboratory For Physics 302L, 303L, and 317L	1
	Hours	**16**
Semester 2		
E S 333T	Engineering Communication	3
BME 313L	Introduction to Numerical Methods in Biomedical Engineering	3
BME 335	Engineering Probability and Statistics	3
BME 344	Biomechanics (advisor approval required)	3
BCH 369	Fundamentals of Biochemistry	3
Social and Behavioral Sciences (080)		3
	Hours	**18**
Year 3		
Semester 1		
BME 245L	Experimental Principles of Biomedical Engineering Design	2
BME 343	Biomedical Engineering Signal and Systems Analysis	3
BME 365R	Quantitative Engineering Physiology I	3
BME 352	Engineering Biomaterials	3
Technical Elective		3
Humanities (040)		3
	Hours	**17**
Semester 2		
BME 261L	Development and Analysis in Biomedical Engineering Design	2
BME 349	Biomedical Instrumentation	3
BME 365S	Quantitative Engineering Physiology II	3
BME 353	Transport Phenomena in Living Systems	3
BME 355	Molecular Engineering (advisor approval required)	3
Technical Elective		3
	Hours	**17**
Year 4		
Semester 1		
BME 370	Biomedical Engineering Capstone Design I	3
Technical Elective		3
Visual and Performing Arts (050)		3
U.S. History (060)		3
American and Texas Government (070)		3
	Hours	**15**
Semester 2		
BME 371	Biomedical Engineering Capstone Design II	3
Technical Elective		3
U.S. History (060)		3
American and Texas Government (070)		3
	Hours	**12**
	Total Hours	**132**

Requirements

All requirements are listed below, starting with the most specialized moving to the most general. Additional requirements may follow the table, so be sure to read the entire page. Some required courses listed below may also satisfy General Education requirements, including Core Curriculum.

Code	Title	Hours
Concentration		
Hours chosen from: (six hours must be within engineering, remaining hours may be within or outside engineering)		12
BME 322	Health Equity in Engineering Design	
BME 336	Cancer Bioengineering	
BME 342	Biomechanics of Human Movement	
BME 346	Computational Biomolecular Engineering	
BME 347	Fundamentals of Biomedical Optics	

BME 354	Molecular Sensors and Nanodevices for Biomedical Engineering Applications	
BME 358M	Imaging Clinical Immersion	
BME 359	Cellular and Molecular Biomechanics	
BME 365	Tissue Microenvironments	
BME 372P	Mathematical Physiology	
BME 373	Tissue, Scaffold, and Cell Biomechanics Applications	
BME 376	Cell Engineering	
CHE 339P	Introduction to Biological Physics	
KIN 326K	Biomechanical Analysis of Movement	
M E 314D	Dynamics	
M E 344	Dynamic Systems and Controls	
M E 354	Introduction to Biomechanical Engineering	
M E 372J	Robotics and Automation	
An approved upper-division biomedical engineering or mechanical engineering course		
Subtotal		*12*
Degree (see details below)		**96**
Free electives: Additional coursework to reach total hours required.		0
Subtotal		*96*
General Education		
Remaining Core Curriculum (42 hours total)		24
Foreign Language other than English, Beginning Proficiency		
Subtotal		*24*
College Requirements - Engineering		
General University Requirements		
Total Hours		**132**

Additional Requirements and Policies

Current technical elective lists are available on the departmental undergraduate advising office's website.

Degree-Bachelor of Science in Biomedical Engineering (BSBiomedE)

Requirements

Code	Title	Hours
Degree		
Biomedical Engineering		
BME 214L	Computational Fundamentals of Biomedical Engineering Design	2
BME 245L	Experimental Principles of Biomedical Engineering Design	2
BME 261L	Development and Analysis in Biomedical Engineering Design	2
BME 303	Introduction to Computing	3
BME 303L	Introduction to Biomedical Engineering Design	3
BME 311	Network Analysis in Biomedical Engineering (advisor approval required)	3
BME 313L	Introduction to Numerical Methods in Biomedical Engineering	3
BME 335	Engineering Probability and Statistics	3
BME 343	Biomedical Engineering Signal and Systems Analysis	3
BME 344	Biomechanics (advisor approval required)	3
BME 349	Biomedical Instrumentation	3
BME 352	Engineering Biomaterials	3
BME 353	Transport Phenomena in Living Systems	3
BME 355	Molecular Engineering	3
BME 365R	Quantitative Engineering Physiology I	3
BME 365S	Quantitative Engineering Physiology II	3
BME 370	Biomedical Engineering Capstone Design I	3
BME 371	Biomedical Engineering Capstone Design II	3
Subtotal		*51*
Biochemistry and Biology		
BCH 369	Fundamentals of Biochemistry	3
BIO 206L	Introductory Laboratory Experiments in Biology	2
BIO 311C	Introductory Biology I	3
Subtotal		*8*
Chemistry		
CH 401	Principles of Chemistry I	4
CH 402	Principles of Chemistry II	4
CH 320M	Organic Chemistry I	3
or CH 328M	Organic Chemistry I	
Subtotal		*11*
Mathematics		
M 408C	Differential and Integral Calculus	4
M 408D	Sequences, Series, and Multivariable Calculus	4
M 427J	Differential Equations with Linear Algebra	4
Subtotal		*12*
Physics		
PHY 105M	Laboratory For Physics 302K, 303K, and 317K	1
PHY 105N	Laboratory For Physics 302L, 303L, and 317L	1
PHY 303K	Engineering Physics I	3
PHY 303L	Engineering Physics II	3
Subtotal		*8*
Rhetoric and Writing		
RHE 306	Rhetoric and Writing	3
Additional Required Hours		
E S 333T	Engineering Communication	3
Subtotal		*6*
Total Hours		**96**

Additional Requirements and Policies

Prior to registration, students must receive approval from the advising office for courses to be used to fulfill technical and nontechnical course requirements. The student must take all courses required for the degree on the letter-grade basis and must earn a grade of at least *C-* in each, except for those listed as remaining Core Curriculum.

Each student should choose a concentration by the end of the sophomore year and plan an academic program to meet the area requirements during the next two years.

Plan II Honors Program

Students enrolled in the Plan II Honors Program are encouraged to contact the Biomedical Engineering Academic Advising Office, in addition to the Plan II Office to ensure that requirements for both programs are met. Plan II courses may count toward biomedical engineering program requirements.