Welcome to Biomedical Engineering

Welcome to Washington University’s ABET accredited program in Biomedical Engineering. Our overall objective is to prepare those receiving a bachelor’s degree in biomedical engineering for a variety of career paths. To that end, our undergraduate curriculum is designed to provide technical proficiency, and other professional skills so that our graduates will be able to:

1. Pursue careers in the biomedical engineering industry or related fields.
2. Undertake advanced study (e.g., MS, PhD) in biomedical engineering or a related field.
3. Complete professional degrees (e.g., in medicine, dentistry, law).

In your first two years, you will build a foundation in mathematics, physics, chemistry, biology and traditional engineering disciplines. In your later years, you will integrate these foundational studies to create models of physiological processes and develop technologies to interact with biological systems. Finally, you will tailor your training with high level elective courses that will allow you to specialize in areas of interest to you. You’ll meet all these goals through hard work, planning and open communication with professors and academic advisers. This handbook gives an overview of the requirements for a Biomedical Engineering major and introduces you to the department’s faculty and staff. We look forward to working with you.

Daniel W. Moran, PhD
Professor and Director of Undergraduate Studies,
Department of Biomedical Engineering, School of Engineering & Applied Science

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**BME curriculum**

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**BME curriculum**

**Freshman Year**

<table>
<thead>
<tr>
<th>FALL 2015</th>
<th>Credits</th>
<th>SPRING 2016</th>
<th>Credits</th>
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<tr>
<td>BME 140</td>
<td>Intro BME</td>
<td>3</td>
<td>Biology I</td>
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<tr>
<td>Chem 111A</td>
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<td>Chem 112A</td>
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<td>Chem 131</td>
<td>Chem Lab I</td>
<td>2</td>
<td>Chem 132</td>
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<td>Math 132</td>
<td>Calculus II</td>
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<td>Math 233</td>
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<tr>
<td>Phys 117A</td>
<td>Physics I</td>
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**Sophomore Year**

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<td>Biol 297D</td>
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<td>Biology III</td>
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<tr>
<td>ESE 230</td>
<td>Elect Networks</td>
<td>4</td>
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<tr>
<td>Math 312</td>
<td>Diff Equations</td>
<td>3</td>
<td>ESE 319</td>
</tr>
<tr>
<td>H/SS Elect I</td>
<td>3</td>
<td>CSE 200**</td>
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**Junior Year**

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<th>SPRING 2018</th>
<th>Credits</th>
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<tr>
<td>BME 301A</td>
<td>Quant Phys I</td>
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<td>BME 320B</td>
<td>BME Thermo</td>
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<td>ESE 326</td>
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<td>EP 310</td>
<td>Tech Writing</td>
<td>3</td>
<td>ESE 330</td>
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<tr>
<td>ESE 318</td>
<td>Eng Math A</td>
<td>3</td>
<td>BME 366 *</td>
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<tr>
<td>Eng Elect I</td>
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<td>H/SS Elect I</td>
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**Senior Year**

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<th>FALL 2018</th>
<th>Credits</th>
<th>SPRING 2019</th>
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<tbody>
<tr>
<td>BME 401A</td>
<td>Senior Design</td>
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<td>Senior Des. II</td>
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<td>Eng Elect II</td>
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<td>Engr 450X</td>
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<td>Eng Elect III</td>
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<td>Eng Prof Value</td>
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<tr>
<td>General Elect I</td>
<td>3</td>
<td>General Elect II</td>
<td>3</td>
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<tr>
<td>H/SS Elect IV</td>
<td>3</td>
<td>H/SS Elect V</td>
<td>3</td>
</tr>
<tr>
<td><strong>14</strong></td>
<td></td>
<td><strong>14</strong></td>
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</tbody>
</table>

**Total Credits = 120**

Notes: Subscripts are Engineering Topics Credits
- Engr 450X corresponds to 4501, 4502 and 4503 one credit course
- Students may also take E44 301 Transport Phenomena I: Basics and Fluid Mechanics
- **Students may also take E81 CSE 131 Computer Science I**

The BS in Biomedical Engineering requires completion of the courses in the core curriculum, four upper-level engineering electives, five humanity/social science electives, and two general electives (see sample curriculum on the left). Students must also meet all SEAS and WashU requirements (including the English Composition requirement); and, to satisfy ABET requirements for a professional degree, must accrue 47 engineering topics credits over their coursework.
Electives
Students must complete four upper-level engineering courses beyond the core to complete the major and to prepare for particular fields of employment or education beyond the baccalaureate degree. All four of these courses need to carry 3 or more academic credits and 3 or more engineering topics credits. At least two of the four courses need to be drawn from the Tier I course list with the remaining two drawn from Tier II course list (see department website for current list of Tier I and II courses).

Double majors
Students majoring in Biomedical Engineering may choose to double major within SEAS, leading to a second professional Bachelor of Science degree in one of the other engineering disciplines in four years. A degree in Biomedical Engineering combined with a professional degree in one of the traditional engineering disciplines can be expected to enhance employment opportunities in industry. Depending upon the second major chosen, total unit requirements may range from 140 to 148 (or fewer if the student enters with AP credits). Hence, some summer work may be necessary in order to complete a double major within four academic years. To determine the specific requirements to be satisfied for both degrees, students are urged to consult with an adviser in the second department and their four-year adviser as early as possible.

Independent study
During their course of study, students may receive up to 6 academic credits for BME 400, 404A, 408B and/or 460C (see the department for the full policy on Independent Study). Three credits (one semester) of 400C may be used to fulfill one course in Tier II. First, the student must reach an agreement with a faculty member, who is willing to serve as supervisor, as to the objective and scope of the Project. The faculty supervisor must be either full time in the School of Engineering or affiliated with the Department of Biomedical Engineering. In cooperation with the faculty supervisor, the student will prepare a written proposal (see department website for specific requirements) and submit it with a Request for Approval form.

The student, supervisor and the student’s academic adviser, must sign the form. The proposal and the form must be submitted five working days prior to the last day to add a course. The proposal will be evaluated by the Biomedical Engineering Department Undergraduate Studies Committee and approved for total course credits and engineering topics credits. A copy of the approved proposal shall be placed in the student’s file.

Specialized interests
Sophomores who identify interest toward integrating biomedical engineering with upper-level coursework in one of the other four SEAS departments should take the corresponding sophomore-level course listed below as one of their electives. This course does not fulfill a core or upperlevel requirement, but will substantively improve preparation for integrative courses taken within BME and across SEAS.

CSE 241 Algorithms and Data Structures
EECE 201 Engineering Analysis of Chemical Systems
ESE 232 Introduction to Electronic Circuits
MEMS 255 Engineering Mechanics II

The abbreviations below will help students choose upper-level electives according to their interests. For example, BME 533 includes elements of Computer Science and Electrical & Systems Engineering.

CH = Energy, Environment & Chemical Engineering (EECE)
CS = Computer Science & Engineering (CSE)
ES = Electrical & Systems Engineering (ESE)
MM = Mechanical Engineering & Materials Science (MEMS)
A = All

Bachelor’s/Master’s (BS/MS) Program in Engineering
This program allows current BME undergraduate students to earn a master’s degree with only one additional year of study. Interested engineering students should discuss the program with their advisor by the end of their junior year in order to best develop a plan for their senior year leading into their master’s year. With adviser and departmental approval, up to six graduate-level units can be shared between the BS and MS degrees; however, the combined program still requires students to complete a minimum of 150 units in total.

Premedicine
Premedicine is not a major. Medical schools require a four-year undergraduate degree that generally includes:

» One year of English
» One year of physics with lab
» One year of biology with lab
» Two years of chemistry with lab, including organic chemistry
» Individual medical schools may have additional requirements. Check the specific requirements of the institutions where you plan to apply.

engineering.wustl.edu/premed

Premedicine Contact:
Ron Laue, PhD
Assistant Dean & Health Professions Adviser for the School of Engineering & Applied Science
Lopata Hall, Room 303 or (314) 935-6179
Ron.Lau@wustl.edu or premedicine@seas.wustl.edu

Other Resources
Engineering Student Services:
» Lopata Hall, Room 303
» (314) 935-6100 or ess@seas.wustl.edu
» engineering.wustl.edu/ess

Engineering Communications Center:
» Urbauer Hall, Room 104 (off of Lopata Gallery’s east side)
» ecc@seas.wustl.edu
» engineering.wustl.edu/ecc

Engineering Information Technology:
» Lopata Hall, Room 408
» (314) 935-5097 or support@seas.wustl.edu
» engineering.wustl.edu/it

Career Center:
» Danforth University Center, Suite 110
» Lopata Hall, Room 303 (by appointment)
» careercenter.wustl.edu
» Michael Chapin: Assistant Director, Career Development - Engineering
» (314) 935-7470 or mchapin@wustl.edu

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» Michael Chapin: Assistant Director, Career Development - Engineering
» (314) 935-7470 or mchapin@wustl.edu
Mark Anastasio
Professor and Associate Chair
Whitaker Hall, Room 2009
(314) 935-3637
anastasio@wustl.edu
Research interests: Development of biomedical imaging methods; photoacoustic tomography; X-ray phase-contrast imaging; image reconstruction and inverse problems in imaging; theoretical image science

Dennis Barbour
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Research interests: Systems and computational neuroscience; sensory neurophysiology; brain-computer interfaces; neural plasticity; app development for health informatics

Jan Bencsigh
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Research interests: Nanomaterials; single molecule dye; single molecule fluorescence; atomic force microscopy

Hong Chen
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Research interests: Ultrasound imaging; ultrasonic therapy; image-guided drug delivery

Jianxin Cui
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Research interests: Molecular imaging: ultrasound therapy; image-guided drug delivery

Donald Elbert
Professor
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Barani Raman
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Research interests: Biotechnology; computer interfaces; motor control; brain-computer interfaces

Kristen Naegle
Assistant Professor
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Research interests: Biophysics of intrinsically disordered proteins; protein-protein interactions and its effects on transcriptional regulation; phase transitions in cell biology

Jin-Yu Shao
Associate Professor
Whitaker Hall, Room 390E
(314) 935-7958
shao@wustl.edu
Research interests: Protein aggregation and its effects on neurodegeneration; biophysics of intrinsically disordered proteins; protein-nucleic acid interactions and modeling of transcriptional regulation; phase transitions in cell biology

Rohit Pappu
Professor
Brauer Hall, Room 2006
(314) 935-7958
rohit@wustl.edu
Research interests: Biotechnology; cell and tissue engineering; drug delivery in musculoskeletal regeneration and drug delivery in musculoskeletal disease

Lihong Wang
Professor
Whitaker Hall, Room 190D
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lhwang@wustl.edu
Research interests: Biophotonic imaging

Larry Taber
Professor
Whitaker Hall, Room 300E
(314) 935-8544
larrytaber@wustl.edu
Research interests: Biomechanics of cardiovascular and nervous system development