## Biomedical Engineering

### Freshman Year

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Spring Semester</th>
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<tbody>
<tr>
<td>Chem 1061/65 Chem Princ I (placement into course, or 1015)</td>
<td>Chem 1062/66 Chem Princ II (1061/1065)</td>
</tr>
<tr>
<td>Math 1371 Calculus I (placement into course, or pre-req)</td>
<td>Math 1372 Calculus II (1371)</td>
</tr>
<tr>
<td>Phys 1301W Intro Physics I &amp; (Math 1371)</td>
<td>Phys 1302W Intro Physics II (1301, &amp;Math 1372)</td>
</tr>
<tr>
<td>BMEn 1601 UG Seminar I</td>
<td>BMEn 1602 UG Seminar II</td>
</tr>
<tr>
<td>Liberal Education course or Writ 1301</td>
<td>Liberal Education course or Writ 1301</td>
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### Sophomore Year

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<tr>
<th>Fall Semester</th>
<th>Spring Semester</th>
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<tbody>
<tr>
<td>BMEn 2401 Prmg for BME (Math 1372, Phys 1302)</td>
<td>BMEn 2101 Biothermodyn. (Math 1372, Chem 1062/66, Phys 1302)</td>
</tr>
<tr>
<td>BMEn 2501 Molec/Cell Biol w/lab (Math 1372, Chem 1062/66, Phys 1302)</td>
<td>Math 2374 Multiv. Calculus (1372)</td>
</tr>
<tr>
<td>Chem 2301 Organic Chem I (1062/1066)</td>
<td>Math 2373 Lin Alg/Diff Eq (1372)</td>
</tr>
<tr>
<td>BMEn 2101 Biothermodyn. (Math 1372, Chem 1062/66, Phys 1302)</td>
<td>Liberal Education course</td>
</tr>
<tr>
<td>BMEn 2501 Molec/Cell Biol w/lab (Math 1372, Chem 1062/66, Phys 1302)</td>
<td>Liberal Education course</td>
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### Junior Year

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<thead>
<tr>
<th>Fall Semester</th>
<th>Spring Semester</th>
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<tbody>
<tr>
<td>Phsl 3061 Prin. of Physiology (UD, 1 Year College Math, Physics, Chem)</td>
<td>BMEn 3311/15 Biomaterials (UD, Math 2374, Phys 1302)</td>
</tr>
<tr>
<td>Phsl 3701 Physiology Lab</td>
<td>BMEn 3111/15 Biomed Tnspt (UD, 3011/15 Math 2374, Phys 1302)</td>
</tr>
<tr>
<td>BMEn 3011/15 Biomechanics (UD, Math 2374, Phys 1302)</td>
<td>BMEn 3411/15 BMed Sys Analy (3211, 3111, 2401)</td>
</tr>
<tr>
<td>BMEn 3211/15 Bioelec/Instr (UD, Math 2374, Phys 1302)</td>
<td>Technical Elective</td>
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### Senior Year

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<thead>
<tr>
<th>Fall Semester</th>
<th>Spring Semester</th>
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<tbody>
<tr>
<td>BMEn 4001W Design I (2501, 3011, 3111 3211, 3311, 3701)</td>
<td>BMEn 4002W Design II (4001W)</td>
</tr>
<tr>
<td>Technical Elective</td>
<td>Technical Elective</td>
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<tr>
<td>Technical Elective</td>
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### About This Plan

- This plan is not a contract. Curriculum can change.
- Shaded courses are only offered in the indicated semester.
- Course pre-requisites and co-requisites (designated by & are listed below the course number and title. UD requires admission to the major prior to enrollment.
- Students can take either the CSE-only or University-wide versions of the math courses (Math 1371/1271, 1372/1272, 2373/2243, 2374/2263).
- Double boxed courses, along with one of two courses with a dashed outline, are required for application to this major.
- Chemical Principles labs (1065/1066) must be taken concurrently with the lectures (1061/1062).
- BMEn 3xx level lectures and labs must be taken concurrently.
- Liberal Education and Writing requirements with an (*) will be fulfilled by taking courses required for this major at UM-TC.

### Applying to your Major

Students who have completed the required courses for admission to this major and have a 3.2 UM-TC technical GPA at the end of the fall semester will be guaranteed admission. All other students who have completed the required courses will be considered for admission on a space-available basis. Admission following the spring semester is only based on space availability. The major application database is available at z.umn.edu/csemajorapp.

### Department Contact Information

- Website: http://bme.umn.edu/undergrad/
- Main Phone: 612-624-4507
- Main Office: 7-105 Hasselmo Hall
- Director of Undergraduate Studies: Professor Taner Akkin
- Departmental Advisor: Ashlee Haluptzok; bmedus@umn.edu

### University Degree Requirements

All students must complete the following Writing & Liberal Education requirements, as noted on their APAS report. See link for full Core & Theme names: z.umn.edu/liberaleducation

### Writing Requirements:

- **University Writing:**
  - Writ 1301/1401 or equivalent
- **Writing Intensive (WI):**
  - Two: 1xxx or 2xxx level**
  - One: 3/4/5xxx level (in major)*
  - One: 3/4/5xxx level (any dept.)*

### Liberal Education

<table>
<thead>
<tr>
<th>CORES:</th>
<th>THEMES:</th>
</tr>
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<tbody>
<tr>
<td>Bio*</td>
<td>Civ:</td>
</tr>
<tr>
<td>Phy*</td>
<td>DSJ:</td>
</tr>
<tr>
<td>His</td>
<td>Env:</td>
</tr>
<tr>
<td>SocS</td>
<td>GP:</td>
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<td>Ltr</td>
<td>TS:</td>
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<tr>
<td>AH</td>
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<tr>
<td>Mth*</td>
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### Total Credits Needed for Degree: 124
By combining biology and medicine with engineering principles and practices, biomedical engineers develop devices and procedures to solve medical and health-related problems. Along with life scientists, chemists, and medical scientists, many biomedical engineers develop and evaluate systems and products such as artificial organs, prostheses (artificial devices that replace missing body parts), instrumentation, medical information systems, health management, and care delivery systems. Biomedical engineers also design devices used in various medical procedures, such as the cardiac pacemaker, computers used to analyze blood, laser systems used in corrective eye surgery, and imaging systems such as magnetic resonance imaging (MRI). They may develop artificial organs, imaging systems such as ultrasound, and devices for automating insulin injections or controlling body functions. Biomedical engineering can also involve the applications of basic principles to the quantitative modeling and simulation of physiological systems. Some specialties within biomedical engineering include:

- Bioinstrumentation—Application of electronics and measurement techniques to develop medical devices
- Biomaterials—Understanding of materials for placement in the human body
- Biomechanics—Study of motion and flow within devices and the human body
- Cellular, Tissue, and Genetic Engineering—Development of devices to attack biomedical problems on the microscopic level
- Clinical Engineering—Intersection of technology and healthcare
- Medical Imaging—Electronic data processing and analysis to display medical images in non-invasive ways
- Orthopedic Bioengineering—Understanding of bones, joints, and muscles to design artificial replacements
- Rehabilitation Engineering—Improvement of the quality of life for people who have physical and cognitive impairments
- Systems Physiology—Understanding of the function of living organisms

**Employers** *(sample listing)*

- Accenture
- Heraeus Medical Components
- National Instruments
- AMS
- Mayo Clinic
- St. Jude Medical
- Beckman Coulter
- Medical Graphics Corps
- Starkey Laboratories
- Boston Scientific
- Medtronic
- Vascular Solutions
- General Electric
- Minnetronix
- Zimmer, Inc.

**Industries** *(sample listing)*

- Healthcare
- Laboratories
- Pharmaceuticals
- Biomaterials
- Institutes
- Medical software companies
- Biotechnology
- Bio-instrumentation
- Medical imaging
- Invasive devices
- Biomechanics
- Orthopedics
- Universities
- Tissue and cellular engineering
- Diagnostics

**Positions** *(sample listing)*

**Research and Development Manager:** Develops new products and improves existing products for medical device equipment.

**Quality Engineer:** Ensures that medical devices meet FDA standards for safety and efficacy.

**Biomechanical Engineer:** Develops mechanical devices such as artificial hips, hearts, and kidneys.

**Manufacturing Engineer:** Ensures that medical devices are manufactured in a cost-effective and efficient manner.

**Sales Engineer:** Uses technical expertise to sell products, write technical support documents, and works with both sales staff and design engineers.

**Clinical Engineer:** Works directly with doctors to train them on devices.

**Rehabilitation Engineer:** Designs, develops, adapts, tests, evaluates, applies, and distributes technological solutions to problems confronted by individuals with disabilities.

**Prosthesis Designer:** Designs, creates, and fits prosthetic devices such as artificial limbs for patients.

**Medical Device Designer:** Uses technology and research to design new medical devices.

*Some positions may require an advanced degree*