**Major: Biomedical Engineering (BME)**

Accredited by: NY State Department of Education  
Offered by: Nance E. and Peter C. Meinig School of Biomedical Engineering  
101 Weill Hall, 255.

**Program Mission**
The mission of the B.S. program in Biomedical Engineering is to train students in the practice of design, fabrication, and analysis of biomedical systems, devices, diagnostics, and therapeutics. Specifically, Cornell’s vision for Biomedical Engineering centers around a quantitative approach to understanding biology across length and time scales, with a focus on issues related to human health. The quantitative nature of this program distinguishes the major from traditional programs in biology, while the focus on human health is distinct from other programs in engineering that include the study of biological systems (e.g. Biological and Environmental Engineering and Chemical and Biomolecular Engineering). Additionally, its focus on multiscale analysis of biological systems is a unique signature of Cornell Biomedical Engineering relative to programs at peer institutions.

**Program Objectives**
Biomedical Engineering is a leader in developing research that spans the Ithaca and New York City campuses, including Weill Cornell Medical College and Cornell Tech. Our objective is to create world-class graduates to meet the 21st century needs of biomedical-related industries focused on medical devices and pharmaceuticals, as well as government and private consulting practice. We also aim to produce intellectual and technical leaders for graduate education in medicine or engineering. Most importantly, we aim to create a diverse community of life-long learners who are innovation confident, collaborative across disciplines, and community engaged.

Objective 1: Teach our students to apply engineering principles to understand and predict the behavior of biological and physiological systems relevant to human health and disease  
Objective 2: Train our students in the theory and practice of biomedical engineering design and technology creation  
Objective 3: Train our students to engineer robust solutions within highly variable and complex biomedical problems  
Objective 4: Build critical leadership, interpersonal and professional skills to thrive within diverse team environments and prepare for life-long learning  
Objective 5: Provide our students with opportunities for an experiential learning approach based on biomedical applications  
Objective 6: To provide a complementary liberal education in humanities, history and social sciences

**Engineering Distributions**

ENGRD 2202: Biomedical Transport Phenomena (required)  
ENGRD 2020: Statics and Mechanics of Solids (recommended)  

**Required Major Courses**

BIOMG 1350: Introductory Biology: Cell and Developmental Biology or  
BIOG 1440: Introductory Biology: Comparative Physiology  
BIOG 1500: Investigative Biology Lab  
ENGRD 2020: Statistics and Mechanics of Solids  
BME 2010: Systems Pathophysiology  
BME 2110: Biomolecular Thermodynamics and Physical Chemistry  
BME 2310: Biomedical Signals and Systems Analysis  
BTRY 3010: Biological Statistics  
BME 2210: Biomedical Applications of Materials  
BME 3010: Molecular Principles of Biomedical Engineering  
BME 3020: Cellular Principles of Biomedical Engineering  
BME 3030: Biomedical Instrumentation and Technology Fabrication  
BME 4010: Biomedical Engineering Analysis of Metabolic and Structural Systems  
BME 4020: Electrical and Chemical Physiology  
BME 4080/4090: Biomedical Engineering Design Laboratory
Biomedical Engineering Concentrations (Must Choose 1)

Molecular, Cellular, and Tissue Engineering (MCTE)
Required Courses:
CHEM 1570: Introduction to Organic and Biological Chemistry
BME 3110: Engineering and Computational Analysis of Cellular Systems
BME 4190: MCTE Practicum Laboratory
Electives:
Choose 6 credits from the following courses:
BTRY 4381: Bioinformatics Programming
BME 5850: Current Practices in Tissue Engineering
BME 5830: Cell-Biomaterials Interactions
CHHEME 5430: Bioprocess Engineering
OR 1 3xxx/4xxx course from another BME Concentration

Biomedical Materials and Drug Delivery (BMDD)
Required Courses:
CHEM 1570: Introduction to Organic and Biological Chemistry
BME 3210: BDD Concentration Course
BME 4190: MCTE Practicum Laboratory. or
BME 4490: BMMB Practicum Laboratory
Electives:
Choose 6 credits from the following courses:
BEE 3650: Properties of Biological Materials
MSE 4020: Mechanical Properties of Materials; Processing and Design, or
MAE 4640: Orthopedic Tissue Mechanics, or
MSE 5230: Physics of Soft Materials, or
BME 5810: Soft Tissue Biomechanics
BEE 4940: Design and Analysis of Biomaterials
CBE 5430: Bioprocess Engineering
MSE 5550: Introduction to Composite Materials
MSE 5620: Biomineralization
BME 5830: Cell-Biomaterial Interactions
BME 5850: Current Advances in Tissue Engineering

Biomedical Imaging and Instrumentation (BII)
Required Courses:
PHYS 2214: Physics III: Oscillations, Waves, and Quantum Physics
BME 3310: Medical and Preclinical Imaging
BME 4390: Circuits, Signals, and Sensors Instrumentation Laboratory
Electives:
Choose 6 credits from the following courses:
AEP 3300: Modern Experimental Optics
ECE 4300: Lasers and Optoelectronics
BEE 4590: Biosensors and Bioanalytical Techniques
ECE 4910: Principles of Neurophysiology
ECE 4760: Designing with Microcontrollers
Biomedical Mechanics and Mechanobiology (BMMB)

Required Courses:
PHYS 2214: Physics III: Oscillations, Waves, and Quantum Physics
BME 4410: BMMB Concentration Course
BME 4490: BMMB Practicum Laboratory

Electives:
Choose 6 credits from the following courses:
MAE 4640: Orthopaedic Biomechanics
MAE 4680: Biofluid Mechanics
BME 5810: Soft Tissue Biomechanics
MSE 5130: Mechanobiology of Materials and Cells
BEE 3310: Bio-Fluid Mechanics
BEE 4530: Computer Aided Engineering
Requirements for Major Affiliation: Biomedical Engineering

Affiliation requirements are available on the Engineering Advising display board in 167 Olin Hall, or visit the BME undergraduate website at http://www.bme.cornell.edu/bme/academics/undergraduate/affiliation/index.cfm

Note: Liberal Studies Distribution and Physical Education requirements are not represented on this chart.
## Biomedical Engineering Major Check List

### Core Science and Engineering Courses (69 credit minimum)

<table>
<thead>
<tr>
<th>Course</th>
<th>Min. Credit Hours</th>
<th>√ When Done</th>
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<tbody>
<tr>
<td>MATH 1910</td>
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<td>MATH 1920</td>
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<td>MATH 2930</td>
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<tr>
<td>MATH 2940</td>
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<tr>
<td>CHEM 2090</td>
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<tr>
<td>PHYS 1112 (or 1116)</td>
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<tr>
<td>PHYS 2213 (or 2218)</td>
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<tr>
<td>PHYS 2214 or CHEM 1570</td>
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<tr>
<td>CS 1112 (or 1110, or 1114, or 1115)</td>
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<tr>
<td>Introduction to Engineering: ENGRI 1XXX</td>
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<tr>
<td>Engineering Distribution 1: ENGRD 2202 (required)</td>
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<tr>
<td>Engineering Distribution 2: ENGRD 2XXX</td>
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<td>First Year Writing Seminar 1</td>
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<tr>
<td>First Year Writing Seminar 2</td>
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<tr>
<td>Liberal Studies Distribution: six courses, 18-credit minimum</td>
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<td>Liberal Studies 5</td>
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<td>Liberal Studies 6</td>
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<tr>
<td>Advisor-approved Elective 1: two courses, 6-credit minimum</td>
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<tr>
<td>Advisor-approved Elective 2</td>
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### Required Major Courses (credit minimum)

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<tr>
<th>Course</th>
<th>Min. Credit Hours</th>
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<tbody>
<tr>
<td>BIOG 1350 or BIOG 1440</td>
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<td>BIOG 1500</td>
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<tr>
<td>ENGRD 2020</td>
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<tr>
<td>BTRY 3010 or CEE 3040</td>
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<td>BME 2010</td>
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<td>BME 4090</td>
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<td>BME Concentration Course 2</td>
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<tr>
<td>BME Concentration Course 3</td>
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<tr>
<td>BME Concentration Laboratory (BME 4190, BME 4390, or BME 4490)</td>
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### BME Concentration (13 credit minimum)

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<th>Course</th>
<th>Min. Credit Hours</th>
<th>√ When Done</th>
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</thead>
<tbody>
<tr>
<td>BME Concentration Course 1</td>
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</tr>
<tr>
<td>BME Concentration Course 2</td>
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<td></td>
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<tr>
<td>BME Concentration Course 3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>BME Concentration Laboratory (BME 4190, BME 4390, or BME 4490)</td>
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</table>

**Technical Writing Course**: BME Concentration Lab

**Physical Education**: 1 sem 2 sem swim test
Notes

a. Recommended: ENGRD 2020. ENGRD 2020 satisfies the Common Curriculum distribution requirement and also fulfills a required Major course. It is best taken during semester 3 and must be completed before semester 5.

b. BEE 2220 currently satisfies BME 2110.

c. CEE 3040 alternatively satisfies this course.

d. The choice between PHYS 2214 or CHEM 1570 depends on the concentration chosen within the Major. CHEM 1570 can also be satisfied by the pre-medicine organic chemistry/biochemistry sequence. PHYS 2214 is recommended for Biomedical Imaging and Instrumentation (BII), and Biomedical Mechanics and Mechanobiology (BMMB); CHEM 1570 is required for Molecular/Cellular/ Tissue Engineering (MCTE), and Biomaterials and Drug Delivery (BDD).

e. Introduction to Computing (CS 1110, 1112, CS 1114, or CS 1115) is required for affiliation. CS 1112 is recommended.

f. In addition to the First-year Writing Seminars, a technical writing course must be taken as an engineering distribution, liberal studies, approved elective, or Major course. This requirement will be satisfied with the BME Concentration Laboratory.

g. Students will choose 3 BME Concentration Courses and one BME Concentration Laboratory in one of the following concentration areas: Molecular/Cellular/Tissue Engineering (MCTE), Biomaterials and Drug Delivery (BDD), Biomedical Imaging and Instrumentation (BII), and Biomedical Mechanics and Mechanobiology (BMMB).
Requirements for Major Affiliation Fall 2015

Biomedical Engineering (BME)

Minimum GPA of 2.5 in required math, science, and engineering courses completed with at most one grade below C-. Research/project team credit does not apply to this GPA.

Completion of BIOG (1350 or 1440) and BIOG 1500 with grades of at least C. Advanced Placement (AP, IB, GCE credit) CANNOT be used to satisfy this requirement.

Completion of CS1110/1112/1114/1115 and ENGRD2202 with minimum combined GPA of 2.5 and no grade less than C-.

Completion of designated College of Engineering common curriculum by the end of semester 3 of sophomore year (see list below).

For any course that is repeated, the two grades will be averaged.

Meeting the above requirements does not guarantee affiliation with the BME major. During the first years of this new major a selection process balancing the above criteria will be required to manage enrollment. A supplemental application will be distributed by BME upon receipt of the College of Engineering’s “Application for Major Affiliation”.

Participation in volunteer engagement/science-based community/internship/project team/laboratory research activity at Cornell is encouraged.

Designated Engineering Common Curriculum to be completed by end of semester 3 of sophomore year:
- MATH 1910, 1920, 2930
- PHYS 1112, 2213
- CHEM 2090
- BIOG 1440/1350, 1500
- BME 2000/ENGRD 2202
- Any ENGRI
Criteria for Good Standing in Biomedical Engineering

- Semester GPA > 2.3
- Cumulative GPA > 2.1
- No grade below C- in any Core or Concentration Course Required for Graduation \(^1\)
- No failing grade
- Minimum of 12 credits per semester completed with passing grades \(^2\)

\(^1\) Only one course below a C- within major required courses is allowed for graduation.
\(^2\) No course with a grade lower than C- may be used to satisfy a prerequisite for a subsequent BME course.
Biomedical Engineering (BME) Honors Program

To participate in this honors program, students must meet the Majors Honors Programs criteria as delineated above, and must have at least 11 credits beyond the minimum required for graduation in BME (therefore the minimum number of credits to graduate is 141). These 11 credits shall include:

• BTRY 3020 Biological Statistics II – With a grade of at least B+ (4 credits). NOTE: BTRY 3010 is a pre-requisite for BTRY 3020.

• A significant research experience or honors project under the supervision of a BME faculty member using BME 4990 (Undergraduate Research) and BME 4991 (Honors Thesis), to be completed in their fourth year. A written senior honors thesis must be submitted as part of the second component. A minimum grade of A- in both courses is required for successful completion of this honors requirement. The two research courses will be taken in consecutive semesters. (6+ credits)

• A significant teaching experience under the supervision of a BME faculty member or as part of a regularly recognized course in the department under BME 4980: Undergraduate Teaching. (1+ credits)

In addition:

• The student must present a poster or oral presentation in a public research forum such as a national or regional professional society meeting, Bio Expo, or other public university event by the end of the student’s project.

• Project teams are not acceptable for Honors Thesis research unless there is a clearly defined project outside of the team effort attested by the project faculty advisor.

• No research, independent study, or teaching experience for which the student is paid may be counted towards the credits required for the honors program.

Timing

All interested students must complete a written application (available 1xx Weill Hall) no later than the end of the third week of their 7th semester, but students are encouraged to make arrangements with a faculty member during their junior year.

Procedures

Each applicant to the BME Honors Program must have a BME faculty advisor to supervise their honors program. Before enrolling into BME 4990, a written application must be submitted to the director for undergraduate studies. This application must include a brief proposal outlining a research topic, the significance of the topic with respect to human health, and the scope of the proposed project or thesis. A written approval of the faculty member who will direct the research is required to accompany this application. The proposal will be reviewed and either approved, returned back to the student for revision, or rejected. The proposed project must consist of a research, development, and/or design project that fills a clear knowledge or technical gap in the literature. A written report in the format of a technical paper is required at the conclusion of the project. Such reports include sections such as: Introduction, Materials and methods, Results, Discussion, Conclusions. It is expected that the report contain sufficient completeness and detail to be submitted to a peer reviewed journal publication. The report and an associated oral presentation will be evaluated by the BME Honors committee.