B.S./M.S. FIVE-YEAR PROGRAM IN BIOMEDICAL ENGINEERING

Overview

The Department of Biomedical Engineering offers a dual-degree program that culminates with students receiving both Bachelor of Science and Master of Science (BS/MS) in Biomedical Engineering concurrently. This program is available only to qualified students enrolled in the undergraduate program in Biomedical Engineering at the University of Miami. This program is intended to give qualified Biomedical Engineering students the opportunity to acquire both a baccalaureate degree (BSBE) and a Master of Science (MSBE) degree in five years rather than the 4 plus 2 years (approximately) that is traditionally expected. The two degrees are awarded simultaneously when the combined requirements have been met for both degrees.

- Juniors from any of the four BME Concentrations who have maintained at least a 3.0 CGPA have the option to apply for admission to the combined BS-MS in Biomedical Engineering program.
- Those who are accepted into this accelerated program must maintain at least a 3.0 CGPA and a minimum of a 3.0 GPA for the final 30 credit hours to meet the requirements of the Graduate School.
- The participants complete BME 705 (http://bulletin.miami.edu/search/?P=BME%20705/) in lieu of BME 402 (http://bulletin.miami.edu/search/?P=BME%20402/BME%20403).
- Up to 6 credit hours of Technical electives earned during the fourth year can be counted toward the 30 credit hours required for the MS degree. If their schedule allows, students may be able to complete an additional 3 credits of graduate classes during their fourth year.
- Students must be registered for a minimum of 12 undergraduate credit hours per semester in their fourth year.
- Students can register for a maximum of 6 graduate credit hours in each semester of their fourth year.
- If a student needs to withdraw from the BS/MS BME program then all the requirements for the specific BS BME Concentration must be completed for graduation with the BS BME degree.

Admission Requirements

The dual BS/MS program is available only to qualified undergraduate students enrolled in the Department of Biomedical Engineering, in any of the four Concentrations (Electrical, Mechanical, Biomaterials and Tissue, PreMed). Typically, students must have undergraduate student status and a cumulative G.P.A. of at least 3.0 at the time of application.

Undergraduate students must take the Graduate Record Examination (GRE) before the end of their classification as a senior and attain a combined score of more than 300 on the verbal and quantitative portions. Students must meet all other pertinent graduate school and College of Engineering requirements.

Qualified students must apply prior to the beginning of final exams in the second semester of their junior year. Students are strongly advised to apply to the BS/MS program as early as possible in their junior year to facilitate academic advising and course selection in the second semester of their junior year. Before submitting an application, interested students should discuss the program and the possibility of entering the program with an academic advisor.

The College of Engineering Office of Admission will carefully review academic credentials for admission into the program and will notify students of their acceptance into the program. All admitted students will have a special advising appointment with Dr. Narasimhan, Assistant Dean for Undergraduate Studies, to discuss academic issues specific to the BS/MS program.

Curriculum Guidelines

In the dual-degree BS/MS program in the Department of Biomedical Engineering, the first four years of the curriculum are altered as follows:

- The 3 credits of Senior Design Project (BME 402/BME 403) are eliminated.
- In Semester I of the senior year, one 3-credit Undergraduate Technical Elective is replaced with BME 705 (MS Design Project I).
- In Semester II of the senior year, one 3-credit Undergraduate Technical Elective is replaced with one 3-credit Graduate Technical Elective.

Graduate Technical Electives taken in the senior year must be chosen from the BME graduate course offerings, with the approval of their academic advisor. The credits of Graduate Technical Electives completed in the fourth year are counted toward the 30 credits required for the MS degree.

Students admitted in the dual degree BS/MS program can take a maximum of six (6) graduate credits per semester in their senior year, for a maximum of twelve (12) graduate credits per year, without incurring additional costs if they are full-time undergraduate students during this period. Students should register for courses towards their graduate degree as "G" credits and not as "U" credits. These registrations must be completed prior to taking courses. Retroactive add/drops will not be processed.

To register for graduate credits during their senior year, students must be in senior status and must complete and submit the Graduate School's "Application for Undergraduates to Take Graduate Coursework (http://bulletin.miami.edu/programadmin/373/"
undergrad_take_grad_course.pdf” form. This form must accompany the Add/Drop and/or Course Request form to ensure that students are registered with the correct registration status.

In the Senior year, students must be registered for a minimum of 12 undergraduate credits each semester to maintain full-time status as an undergraduate student. After completing the senior year, students must register as graduate students.

**BS/MS Design Project (BME 705/706)**

In lieu of the 3-credit senior design project (BME 402/BME 403) students enrolled in the dual-degree BS/MS program register for 6 credits of Master Design Project (BME 705/BME 706). The 3 credits of BME 705 satisfy the undergraduate senior design requirements, in which students complete a year-long capstone design project that follows the same guidelines and format as BME 402/BME 403. Students enroll in BME 705 during the first semester of their senior year and receive their final project grade at the end of their senior year. The 3 credits of BME 706 satisfy the non-thesis Master’s project requirement. Students enroll in BME 706 during the first semester of their fifth year. The BME 706 project can be a continuation of the student’s BME 705 project, or an entirely new project. The format and guidelines for BME 706 are described in the MS section of the bulletin.

**Graduation Requirements**

Students accepted into the dual degree program must maintain at least a 3.0 Cumulative GPA, and meet all other pertinent Graduate School requirements, including a minimum of 3.0 GPA in the credits applied toward the MS degree.

**Curriculum Requirements**

**BSBE/MSBE (Biomaterials and Tissue Concentration)**

Students in the BSBE Biomaterials and Tissue concentration are required to complete the following courses for the dual degree:

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<thead>
<tr>
<th>Code</th>
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<th>Credit Hours</th>
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<tr>
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<tr>
<td>BME 111</td>
<td>Introduction to Engineering I</td>
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</tr>
<tr>
<td>BME 112</td>
<td>Introduction to Biomedical Engineering</td>
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<td>BME 211</td>
<td>Introduction to Programming for Biomedical Engineers</td>
<td>3</td>
</tr>
<tr>
<td>BME 265</td>
<td>Medical Systems Physiology</td>
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<tr>
<td>BME 266</td>
<td>Human Physiology Laboratory</td>
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<td>BME 302</td>
<td>Cellular Engineering</td>
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<td>BME 303</td>
<td>Cell Engineering Lab</td>
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<td>BME 310</td>
<td>Mathematical Analysis in Biomedical Engineering</td>
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<tr>
<td>BME 330</td>
<td>Foundations of Medical Imaging</td>
<td>3</td>
</tr>
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<td>BME 335</td>
<td>Biomaterials</td>
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<td>BME 375</td>
<td>Fundamentals of Biomechanics</td>
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<td>Biomedical Design</td>
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<td>BME 440</td>
<td>Biomedical Measurements</td>
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<td>Biomedical Transport Phenomena</td>
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<td>BME 480</td>
<td>Biomedical Instrumentation</td>
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<td>BME 512</td>
<td>Regulatory Control of Biomedical Devices</td>
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<td>BME 535</td>
<td>Advanced Biomaterials</td>
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<td>BME 565</td>
<td>Principles of Cellular and Tissue Engineering</td>
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<td>ECE 201</td>
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<td><strong>Math and Science Courses</strong></td>
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<tr>
<td>BIL 150</td>
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<tr>
<td>BIL 151</td>
<td>General Biology Laboratory</td>
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<tr>
<td>BME 312</td>
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<td>CHM 121</td>
<td>Principles of Chemistry</td>
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<td>CHM 113</td>
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<td>CHM 205</td>
<td>Chemical Dynamics Laboratory</td>
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<tr>
<td>CHM 221</td>
<td>Introduction to Structure and Dynamics</td>
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**MTH 151**  
Calculus I for Engineers  
5  

**MTH 162**  
Calculus II  
4  

**MTH 311**  
Introduction to Ordinary Differential Equations  
3  

**PHY 221**  
University Physics I  
3  

**PHY 222**  
University Physics II  
3  

**PHY 223**  
University Physics III  
3  

**PHY 224**  
University Physics II Lab  
1  

**PHY 225**  
University Physics III Lab  
1  

**Additional Requirements**  
**ENG 105**  
English Composition I  
3  

**ENG 107**  
English Composition II: Science and Technology  
3  

**Arts and Humanities Cognate**  
9  

**People and Society Cognate**  
9  

**MSBE REQUIREMENTS**  
**BME 705**  
Senior Design Project  
3  

**Graduate Technical Electives**  
27  

**BME 706**  
Master's Project  
3  

**Total Credit Hours**  
155

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**Curriculum Requirements**  
**BSBE/MSBE (Electrical Concentration)**

Students in the BSBE Electrical concentration are required to complete the following courses for the dual degree:

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<td>Medical Systems Physiology</td>
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<td>BME 266</td>
<td>Human Physiology Laboratory</td>
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<td>BME 310</td>
<td>Mathematical Analysis in Biomedical Engineering</td>
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<td>BME 330</td>
<td>Foundations of Medical Imaging</td>
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<td>BME 335</td>
<td>Biomaterials</td>
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<td>Fundamentals of Biomechanics</td>
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<td>BME 440</td>
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<td>Biomedical Transport Phenomena</td>
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<td>BME 507</td>
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<td>BME 512</td>
<td>Regulatory Control of Biomedical Devices</td>
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<td>BME 540</td>
<td>Microcomputer-Based Medical Instrumentation</td>
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<td>BIL 151</td>
<td>General Biology Laboratory</td>
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<td>BME 312</td>
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<td>CHM 121</td>
<td>Principles of Chemistry</td>
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<td>CHM 113</td>
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<td>MTH 151</td>
<td>Calculus I for Engineers</td>
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<td>MTH 162</td>
<td>Calculus II</td>
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<td>MTH 311</td>
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<td>PHY 221</td>
<td>University Physics I</td>
<td>3</td>
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<td>PHY 222</td>
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<td>PHY 223</td>
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<td>PHY 225</td>
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**Additional Requirements**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>ENG 105</td>
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<td>3</td>
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<tr>
<td>ENG 107</td>
<td>English Composition II: Science and Technology</td>
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<tr>
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<td>People and Society Cognate: 9</td>
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**MSBE REQUIREMENTS**

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<th>Code</th>
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<tbody>
<tr>
<td>BME 705</td>
<td>Senior Design Project</td>
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<tr>
<td>Graduate Technical Electives: 27</td>
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<tr>
<td>BME 706</td>
<td>Master's Project</td>
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**Total Credit Hours** 154

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**Curriculum Requirements**

**BSBE/MSBE (Mechanical Concentration)**

Students in the BSBE Mechanical concentration are required to complete the following courses for the dual degree:

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<tr>
<td>BME 111</td>
<td>Introduction to Engineering I</td>
<td>3</td>
</tr>
<tr>
<td>BME 112</td>
<td>Introduction to Biomedical Engineering</td>
<td>2</td>
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<tr>
<td>BME 211</td>
<td>Introduction to Programming for Biomedical Engineers</td>
<td>3</td>
</tr>
<tr>
<td>BME 265</td>
<td>Medical Systems Physiology</td>
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<tr>
<td>BME 266</td>
<td>Human Physiology Laboratory</td>
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<td>BME 310</td>
<td>Mathematical Analysis in Biomedical Engineering</td>
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<tr>
<td>BME 330</td>
<td>Foundations of Medical Imaging</td>
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<td>BME 335</td>
<td>Biomaterials</td>
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</tr>
<tr>
<td>BME 375</td>
<td>Fundamentals of Biomechanics</td>
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<td>BME 440</td>
<td>Biomedical Measurements</td>
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<td>BME 450</td>
<td>Biomedical Transport Phenomena</td>
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<tr>
<td>BME 460</td>
<td>Introduction to Physiological Fluid Mechanics</td>
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<td>BME 470</td>
<td>Biomedical Signal Analysis</td>
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<td>BME 480</td>
<td>Biomedical Instrumentation</td>
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<td>BME 506</td>
<td>Computer Aided Design in Biomedical Engineering</td>
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<td>BME 512</td>
<td>Regulatory Control of Biomedical Devices</td>
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<td>BME 575</td>
<td>Tissue Mechanics</td>
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<td>ECE 201</td>
<td>Electrical Circuit Theory</td>
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<td>CAE 210</td>
<td>Mechanics of Solids I</td>
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<td>MAE 202</td>
<td>Dynamics</td>
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## Math and Science Courses

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<td>General Biology Laboratory</td>
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<td>BME 312</td>
<td>Biomedical Statistics and Data Analysis</td>
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<td>CHM 121</td>
<td>Principles of Chemistry</td>
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<td>MTH 151</td>
<td>Calculus I for Engineers</td>
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<td>MTH 162</td>
<td>Calculus II</td>
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<td>MTH 311</td>
<td>Introduction to Ordinary Differential Equations</td>
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<td>PHY 221</td>
<td>University Physics I</td>
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<td>PHY 222</td>
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## Additional Requirements

<table>
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<tbody>
<tr>
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<td>English Composition I</td>
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<tr>
<td>Arts and Humanities Cognate</td>
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<td>People and Society Cognate</td>
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## MSBE REQUIREMENTS

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<td>BME 705</td>
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<tr>
<td>Graduate Technical Electives</td>
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<td>BME 706</td>
<td>Master's Project</td>
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Total Credit Hours: 153

## Curriculum Requirements

### BSBE/MSBE (Pre-Med Concentration)

Students in the BSBE Pre-Med concentration are required to complete the following courses for the dual degree:

<table>
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<tbody>
<tr>
<td>BME 111</td>
<td>Introduction to Engineering I</td>
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<td>BME 112</td>
<td>Introduction to Biomedical Engineering</td>
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<td>BME 265</td>
<td>Medical Systems Physiology</td>
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<td>BME 266</td>
<td>Human Physiology Laboratory</td>
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<td>BME 303</td>
<td>Cell Engineering Lab</td>
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<td>BME 330</td>
<td>Foundations of Medical Imaging</td>
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<td>BME 335</td>
<td>Biomaterials</td>
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## Math and Science Courses
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**Additional Requirements**

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**MSBE REQUIREMENTS**

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**Total Credit Hours**: 155

**Suggested Plan of Study**

**Biomaterials and Tissue Concentration**

**Freshman Year**

**Fall**

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**Sophomore Year**

**Fall**

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**Senior Year**

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### Suggested Plan of Study

#### Electrical Concentration

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1. PS/HA Cognate: Students must complete a minimum of 1 People & Society (PS) cognate and 1 Humanities & Arts (HA) cognate, to be selected from the list of available cognates (http://www.miami.edu/index.php/registrar/cognates/). Each cognate should be a minimum of 3 courses (9 credit hours).

2. All Technical Electives are taken as graduate courses. They are graduate-level courses (600 level and above) chosen from the BME course offerings with the approval of the advisor. Non-BME courses need to be approved by the advisor and the chairperson.
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</table>

1 PS/HA Cognate: Students must complete a minimum of 1 People & Society (PS) cognate and 1 Humanities & Arts (HA) cognate, to be selected from the list of available cognates (http://www.miami.edu/index.php/registrar/cognates/). Each cognate should be a minimum of 3 courses (9 credit hours).

2 Technical Electives are chosen from BME course offerings (300 level & above) with the approval of the advisor. Any other course selected needs to be approved by the advisor and the department chairperson.
### Suggested Plan of Study

#### Mechanical Concentration

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<tr>
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<tr>
<td>PHY 221</td>
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<td>PS/HA Cognate $^1$</td>
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<td>Calculus II</td>
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<td>University Physics II</td>
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<td>Introduction to Programming for Biomedical Engineers</td>
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<td>Electrical Circuit Theory</td>
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<td>MTH 311</td>
<td>Introduction to Ordinary Differential Equations</td>
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<td>Human Physiology Laboratory</td>
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<tr>
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<td>Mechanics of Solids I</td>
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<td>PHY 225</td>
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### Suggested Plan of Study

**Pre-Med Concentration**

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<td>ENG 105</td>
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<td>BME 375</td>
<td>Fundamentals of Biomechanics 3</td>
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<td>BME 401</td>
<td>Biomedical Design 3</td>
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### Senior Year

**Fall**

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### Spring

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### Fifth Year (Graduate)

**Fall**

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### Spring

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### Total Credit Hours

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1. **PS/HA Cognate**: Students must complete a minimum of 1 People & Society (PS) cognate and 1 Humanities & Arts (HA) cognate, to be selected from the list of available cognates (http://www.miami.edu/index.php/registrar/cognates/). Each cognate should be a minimum of 3 courses (9 credit hours).

2. Technical Electives are chosen from the BME course offerings (300 level and above) with the approval of the advisor. Any other courses selected need to be approved by the advisor and the department chairperson.

3. Technical Elective Lab is selected from BME 303, BME 395, BME 506, BME 507 or BME 567.

4. All Technical Electives are taken as graduate courses. They are graduate-level courses (600 level and above) chosen from the BME course offerings with the approval of the advisor. Non-BME courses need to be approved by the advisor and the chairperson.
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<thead>
<tr>
<th>Course</th>
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<td>MTH 162</td>
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2. All Technical Electives are taken as graduate courses. They are graduate-level courses (600 level and above) chosen from the BME course offerings with the approval of the advisor. Non-BME courses need to be approved by the advisor and the chairperson.

3. Technical Lab Elective is selected from BME 395, BME 506, BME 507, or BME 567.

4. Can be replaced with an Advanced Bioscience Elective chosen from BIL 250, BIL 255, BIL 268, CHM 222 or BMB 401. Note that CHM 222 is a pre-requisite for BMB 401. Students should verify admission requirements of their medical school of interest to verify Adv. Bioscience requirements, e.g. organic chemistry II, biochemistry, or both.

5. Can be replaced with a science lab that complements the Advanced Bioscience Elective, see footnote 4 (e.g., CHM or BIL lab).

† Students planning on taking the MCAT should take BMB 401 (http://bulletin.miami.edu/search/?P=BMB%20401/) as their first Adv. Bioscience Elective.