

# B.S./M.S. IN BIOMEDICAL ENGINEERING

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## 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 enrolled in BME 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.
- Up to 6 credit hours of engineering 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 6 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 BS degree 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. Typically, students must have undergraduate student status and a cumulative G.P.A. of at least 3.0 at the time of application.

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.

## 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:

- In the senior year, up to two 3-credit Undergraduate Engineering Electives can be replaced with 3-credit Graduate Engineering Electives
- If their schedule allows, students may be able to register for an additional 6 credits of graduate courses in the senior year.

In the fifth year, BS/MS students complete their graduate course requirements, including completion of the MS Project (BME 707 and BME 708). Students in the BS/MS program must also complete exactly two physiology courses chosen from BME 601, BME 602, BME 603 as part of their graduate requirements.

Graduate Engineering Electives taken in the senior year must be chosen from dual-enrollment engineering course offerings, with the approval of their academic advisor. The credits of Graduate Engineering 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 (<https://www.grad.miami.edu/policies-and-forms/forms/>) 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.

## 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

Students in the BSBE/MSBE program are required to complete the following courses for the dual degree::

Code	Title	Credit Hours
<b>BSBE REQUIREMENTS (128 CREDIT HOURS)</b>		
<b>Engineering Courses</b>		
EGN 110	Innovation and Entrepreneurship in Engineering	1-3
EGN 114	Global Challenges Addressed by Engineering and Technology	3
BME 112	Introduction to Biomedical Engineering	2
BME 211	Introduction to Programming for Biomedical Engineers	3
BME 221	(NEW COURSE: Biomedical Design I)	1
BME 222	(NEW COURSE: Biomedical Project I)	2
BME 321	(NEW COURSE: Biomedical Design II)	1
BME 322	(NEW COURSE: Biomedical Project II)	2
BME 335	Biomaterials	3
BME 336	(NEW COURSE: Living Systems Engineering)	3
BME 340	(NEW COURSE: Biomedical Instrumentation I)	4
BME 341	(NEW COURSE: Biomedical Instrumentation II)	3
BME 360	(NEW COURSE: Applied Biotransport)	3
BME 370	(NEW COURSE: Biomedical Signal Analysis)	3
BME 375	Fundamentals of Biomechanics	3
BME 420	(NEW COURSE: Capstone Project I)	3
BME 421	(NEW COURSE: Capstone Project II)	3
BME 512	Regulatory Control of Biomedical Devices	3
Engineering Electives		15
<b>Math and Science Courses</b>		
BIL 150	General Biology	4
BIL 151	General Biology Laboratory	1
BME 265	Medical Systems Physiology	4
BME 310	Mathematical Analysis in Biomedical Engineering	3
BME 312	Biomedical Statistics and Data Analysis	3
CHM 113	Chemistry Laboratory I	1
CHM 121	Principles of Chemistry	4
MTH 151	Calculus I for Engineers	5
MTH 162	Calculus II	4
MTH 311	Introduction to Ordinary Differential Equations	3
PHY 106	College Physics Laboratory I	1
PHY 201	University Physics I for the Sciences	4
PHY 202	University Physics II for the Sciences	4
<b>General Education Requirements</b>		
Written Communication Skills:		
WRS 105	First-Year Writing I	3
WRS 107	First-Year Writing II: STEM	3
Quantitative Skills:		
MTH 151	Calculus I for Engineers (fulfilled through the major)	
Areas of Knowledge:		
Arts and Humanities Cognate		9
People and Society Cognate		9
STEM Cognate (9 credits) (fulfilled through the major)		
<b>MSBE REQUIREMENTS (30 CREDIT HOURS)</b>		
Engineering electives taken as graduate courses		6

Two physiology courses chosen from BME 601, BME 602, BME 603	6
BME 707 Master's Project I	1
BME 708 Master's Project II	2
Five additional graduate courses	15
<b>Total Credit Hours</b>	<b>158</b>

## Curriculum Requirements

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

Students in the BSBE/MSBE Pre-Med track complete the same core curriculum, with a special set of electives that meet the medical school admission requirements:

Code	Title	Credit Hours
<b>BSBE REQUIREMENTS (133 CREDIT HOURS)</b>		
<b>Engineering Courses</b>		
EGN 110	Innovation and Entrepreneurship in Engineering	1-3
EGN 114	Global Challenges Addressed by Engineering and Technology	3
BME 112	Introduction to Biomedical Engineering	2
BME 211	Introduction to Programming for Biomedical Engineers	3
BME 221	(NEW COURSE: Biomedical Design I)	1
BME 222	(NEW COURSE: Biomedical Project I)	2
BME 321	(NEW COURSE: Biomedical Design II)	1
BME 322	(NEW COURSE: Biomedical Project II)	2
BME 335	Biomaterials	3
BME 336	(NEW COURSE: Living Systems Engineering)	3
BME 340	(NEW COURSE: Biomedical Instrumentation I)	4
BME 341	(NEW COURSE: Biomedical Instrumentation II)	3
BME 360	(NEW COURSE: Applied Biotransport)	3
BME 370	(NEW COURSE: Biomedical Signal Analysis)	3
BME 375	Fundamentals of Biomechanics	3
BME 420	(NEW COURSE: Capstone Project I)	3
BME 421	(NEW COURSE: Capstone Project II)	3
BME 512	Regulatory Control of Biomedical Devices	3
<b>Math and Science Courses</b>		
BIL 150	General Biology	4
BIL 151	General Biology Laboratory	1
BIL 160	Evolution and Biodiversity	4
BIL 161	Evolution and Biodiversity Laboratory	1
BMB 401	Biochemistry for the Biomedical Sciences	4
BME 265	Medical Systems Physiology	4
BME 310	Mathematical Analysis in Biomedical Engineering	3
BME 312	Biomedical Statistics and Data Analysis	3
CHM 113	Chemistry Laboratory I	1
CHM 121	Principles of Chemistry	4
CHM 205	Chemical Dynamics Laboratory	1
CHM 206	Organic Reactions and Synthesis Laboratory	2
CHM 221	Introduction to Structure and Dynamics	4
CHM 222	Organic Reactions and Synthesis	4
MTH 151	Calculus I for Engineers	5
MTH 162	Calculus II	4
MTH 311	Introduction to Ordinary Differential Equations	3
PHY 106	College Physics Laboratory I	1
PHY 201	University Physics I for the Sciences	4

PHY 202	University Physics II for the Sciences	4
<b>General Education Requirements</b>		
Written Communication Skills:		
WRS 105	First-Year Writing I	3
WRS 107	First-Year Writing II: STEM	3
Quantitative Skills:		
MTH 151	Calculus I for Engineers (fulfilled through the major)	
Areas of Knowledge:		
Arts and Humanities Cognate		9
People and Society Cognate		9
STEM Cognate (9 credits) (fulfilled through the major)		
<b>MSBE REQUIREMENTS (30 CREDIT HOURS)</b>		
Two physiology courses chosen from BME 601, BME 602, BME 603		6
BME 707	Master's Project I	1
BME 708	Master's Project II	2
Seven additional graduate courses		21
<b>Total Credit Hours</b>		<b>163</b>

## Suggested Plan of Study

<b>Freshman Year</b>		
<b>Fall</b>		<b>Credit Hours</b>
BIL 150	General Biology	4
BIL 151	General Biology Laboratory	1
EGN 114	Global Challenges Addressed by Engineering and Technology	3
MTH 151	Calculus I for Engineers	5
WRS 105	First-Year Writing I	3
<b>Credit Hours</b>		<b>16</b>
<b>Spring</b>		
BME 112	Introduction to Biomedical Engineering	2
CHM 113	Chemistry Laboratory I	1
CHM 121	Principles of Chemistry	4
EGN 110	Innovation and Entrepreneurship in Engineering	1-3
MTH 162	Calculus II	4
WRS 107	First-Year Writing II: STEM	3
<b>Credit Hours</b>		<b>17</b>
<b>Sophomore Year</b>		
<b>Fall</b>		
BME 211	Introduction to Programming for Biomedical Engineers	3
BME 221		1
MTH 311	Introduction to Ordinary Differential Equations	3
PHY 106	College Physics Laboratory I	1
PHY 201	University Physics I for the Sciences	4
PS/HA Cognate <sup>1</sup>		3
<b>Credit Hours</b>		<b>15</b>
<b>Spring</b>		
BME 222		2
BME 265	Medical Systems Physiology	4
BME 310	Mathematical Analysis in Biomedical Engineering	3
PHY 202	University Physics II for the Sciences	4
PS/HA Cognate <sup>1</sup>		3
<b>Credit Hours</b>		<b>16</b>

<b>Junior Year</b>		
<b>Fall</b>		
BME 312	Biomedical Statistics and Data Analysis	3
BME 321		1
BME 340		4
BME 370		3
BME 375	Fundamentals of Biomechanics	3
Engineering Elective <sup>2</sup>		3
<b>Credit Hours</b>		<b>17</b>
<b>Spring</b>		
BME 322		2
BME 335	Biomaterials	3
BME 341		3
BME 360		3
Engineering Elective <sup>2</sup>		3
PS/HA Cognate <sup>1</sup>		3
<b>Credit Hours</b>		<b>17</b>
<b>Senior Year</b>		
<b>Fall</b>		
BME 336		3
BME 420		3
BME 512	Regulatory Control of Biomedical Devices	3
Graduate Engineering Elective <sup>3</sup>		3
Graduate Course <sup>4</sup>		3
PS/HA Cognate <sup>1</sup>		3
<b>Credit Hours</b>		<b>18</b>
<b>Spring</b>		
BME 421		3
PS/HA Cognate <sup>1</sup>		3
PS/HA Cognate <sup>1</sup>		3
Engineering Elective <sup>2</sup>		3
Graduate Engineering Elective <sup>3</sup>		3
Graduate Course <sup>4</sup>		3
<b>Credit Hours</b>		<b>18</b>
<b>Fifth Year (Graduate)</b>		
<b>Fall</b>		
BME 707	Master's Project I	1
Graduate Course <sup>4</sup>		3
Graduate Course <sup>4</sup>		3
Graduate Course <sup>4</sup>		3
<b>Credit Hours</b>		<b>10</b>
<b>Spring</b>		
BME 708	Master's Project II	2
Graduate Course <sup>4</sup>		3
Graduate Course <sup>4</sup>		3
<b>Credit Hours</b>		<b>8</b>
<b>Total Credit Hours</b>		<b>152</b>

<sup>1</sup> 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 (<https://cognates.miami.edu/>). Each cognate should be a minimum of 3 courses (minimum of 9 credits).

<sup>2</sup> Students complete 15 credits of Engineering Electives, which can include a minor in another engineering discipline. Engineering Electives can be chosen from any BME or other engineering course offerings. Students should map their elective sequence in advance to ensure that electives taken in the junior year satisfy the pre-requisites of the electives that they wish to take in the senior year.

<sup>3</sup> Graduate Engineering Electives must be selected from 600 level dual-enrollment BME or engineering course offerings. BME 601, BME 602, and BME 603 or any other 600 level course that does not also have a 500 level section cannot be counted as graduate engineering electives.

<sup>4</sup> Graduate courses are 600 or 700 level courses chosen from the BME course offerings with the approval of the advisor. Up to 6 credits of graduate courses can be taken in other engineering disciplines.

## Suggested Plan of Study

### Pre-Med Track

Freshman Year		
Fall		Credit Hours
BIL 150	General Biology	4
BIL 151	General Biology Laboratory	1
EGN 114	Global Challenges Addressed by Engineering and Technology	3
MTH 151	Calculus I for Engineers	5
WRS 105	First-Year Writing I	3
Credit Hours		16
Spring		
BME 112	Introduction to Biomedical Engineering	2
CHM 113	Chemistry Laboratory I	1
CHM 121	Principles of Chemistry	4
EGN 110	Innovation and Entrepreneurship in Engineering	1-3
MTH 162	Calculus II	4
WRS 107	First-Year Writing II: STEM	3
Credit Hours		17
Sophomore Year		
Fall		
BIL 160	Evolution and Biodiversity	4
BIL 161	Evolution and Biodiversity Laboratory	1
BME 221		1
CHM 205	Chemical Dynamics Laboratory	1
CHM 221	Introduction to Structure and Dynamics	4
MTH 311	Introduction to Ordinary Differential Equations	3
PS/HA Cognate <sup>1</sup>		3
Credit Hours		17
Spring		
BME 211	Introduction to Programming for Biomedical Engineers	3
BME 222		2
CHM 222	Organic Reactions and Synthesis	4
PHY 106	College Physics Laboratory I	1
PHY 201	University Physics I for the Sciences	4
PS/HA Cognate <sup>1</sup>		3
Credit Hours		17
Junior Year		
Fall		
BMB 401	Biochemistry for the Biomedical Sciences	4
BME 265	Medical Systems Physiology	4
BME 310	Mathematical Analysis in Biomedical Engineering	3
BME 321		1
CHM 206	Organic Reactions and Synthesis Laboratory	2
PHY 202	University Physics II for the Sciences	4
Credit Hours		18
Spring		
BME 312	Biomedical Statistics and Data Analysis	3

BME 322		2
BME 335	Biomaterials	3
BME 340		4
BME 370		3
BME 375	Fundamentals of Biomechanics	3
<b>Credit Hours</b>		<b>18</b>
<b>Senior Year</b>		
<b>Fall</b>		
BME 336		3
BME 341		3
BME 420		3
PS/HA Cognate <sup>1</sup>		3
PS/HA Cognate <sup>1</sup>		3
Graduate Course <sup>2</sup>		3
<b>Credit Hours</b>		<b>18</b>
<b>Spring</b>		
BME 360		3
BME 421		3
BME 512	Regulatory Control of Biomedical Devices	3
PS/HA Cognate <sup>1</sup>		3
PS/HA Cognate <sup>1</sup>		3
Graduate Course <sup>2</sup>		3
<b>Credit Hours</b>		<b>18</b>
<b>Fifth Year (Graduate)</b>		
<b>Fall</b>		
BME 707	Master's Project I	1
Graduate Course <sup>2</sup>		3
Graduate Course <sup>2</sup>		3
Graduate Course <sup>2</sup>		3
Graduate Course <sup>2</sup>		3
<b>Credit Hours</b>		<b>13</b>
<b>Spring</b>		
BME 708	Master's Project II	2
Graduate Course <sup>2</sup>		3
Graduate Course <sup>2</sup>		3
Graduate Course <sup>2</sup>		3
<b>Credit Hours</b>		<b>11</b>
<b>Total Credit Hours</b>		<b>163</b>

<sup>1</sup> PS/HA Cognate: Students must complete a minimum of 1 People & Society (PS) cognate and 1 Humanities & Arts (HA) cognate, to be selected from list of available cognates (<https://cognates.miami.edu/>). Each cognate should be a minimum of 3 courses (minimum of 9 credits). Students in Premed Track are highly encouraged to choose cognates that include PSY 110 and SOC 101.

<sup>2</sup> Graduate courses are 600 or 700 level courses chosen from the BME course offerings with the approval of the advisor. Up to 6 credits of graduate courses can be taken in other engineering disciplines.