

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

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## Overview

The College of Engineering offers a dual-degree program that culminates with students receiving a Bachelor of Science in Biomedical Engineering and a Master of Science in Industrial 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 (MSIE) 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 B.S. BME-M.S. IE 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 M.S. 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 B.S. BME/M.S. IE program, then all the requirements for the BS degree must be completed for graduation with the B.S. BME degree.

## Admission Requirements

The dual B.S. BME/M.S. IE program is available only to qualified undergraduate students enrolled in the Department of Biomedical Engineering. Students must have undergraduate student status and a cumulative G.P.A. of at least 3.0 at the time of application.

Qualified students are strongly advised to apply to the dual degree program as early as possible in their junior year to facilitate academic advising and course selection in the second semester of their junior year. Students opting for an M.S. degree in a discipline different from their B.S. degree may need to take some prerequisite coursework. Before submitting an application, students should discuss the program and possibility of entering with an academic adviser.

## Curriculum Guidelines

In the dual-degree B.S. BME /M.S. IE program, 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, dual degree students complete their graduate course 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 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. Only students with a 3.0 CGPA will be permitted to register for graduate classes.

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/MSIE

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

Code	Title	Credit Hours
<b>BSBE REQUIREMENTS (122 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	Biomedical Design I (NEW COURSE: Biomedical Design I)	1
BME 222	Biomedical Project I (NEW COURSE: Biomedical Project I)	2
BME 321	Biomedical Design II (NEW COURSE: Biomedical Design II)	1
BME 322	Biomedical Project II (NEW COURSE: Biomedical Project II)	2
BME 335	Biomaterials	3
BME 336	Living Systems Engineering (NEW COURSE: Living Systems Engineering)	3
BME 340	Medical Instrumentation I (NEW COURSE: Biomedical Instrumentation I)	4
BME 341	Medical Instrumentation II (NEW COURSE: Biomedical Instrumentation II)	3
BME 360	Applied Biotransport (NEW COURSE: Applied Biotransport)	3
BME 370	Biomedical Signal Analysis (NEW COURSE: Biomedical Signal Analysis)	3
BME 375	Fundamentals of Biomechanics	3
BME 420	Capstone Project I (NEW COURSE: Capstone Project I)	3
BME 421	Capstone Project II (NEW COURSE: Capstone Project II)	3
BME 512	Regulatory Control of Biomedical Devices	3
Engineering Electives		9
<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>MSIE REQUIREMENTS (30 CREDIT HOURS)</b>		
Engineering electives taken as graduate courses	6	
ISE 694	Master's Capstone Design Project	3
ISE 712	Design of Experiments	3
ISE 742	Linear Programming and Extensions	3
ISE 757	Ergonomics and Occupational Biomechanics	3
ISE 763	Project Management Techniques	3
or ISE 764	Supply Chain Management	
Three additional graduate courses	9	
<b>Total Credit Hours</b>	<b>152</b>	

## Curriculum Requirements

### BSBE/MSIE (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	Biomedical Design I (NEW COURSE: Biomedical Design I)	1
BME 222	Biomedical Project I (NEW COURSE: Biomedical Project I)	2
BME 321	Biomedical Design II (NEW COURSE: Biomedical Design II)	1
BME 322	Biomedical Project II (NEW COURSE: Biomedical Project II)	2
BME 335	Biomaterials	3
BME 336	Living Systems Engineering (NEW COURSE: Living Systems Engineering)	3
BME 340	Medical Instrumentation I (NEW COURSE: Biomedical Instrumentation I)	4
BME 341	Medical Instrumentation II (NEW COURSE: Biomedical Instrumentation II)	3
BME 360	Applied Biotransport (NEW COURSE: Applied Biotransport)	3
BME 370	Biomedical Signal Analysis (NEW COURSE: Biomedical Signal Analysis)	3
BME 375	Fundamentals of Biomechanics	3
BME 420	Capstone Project I (NEW COURSE: Capstone Project I)	3
BME 421	Capstone Project II (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>MSIE REQUIREMENTS (30 CREDIT HOURS)</b>		
ISE 694	Master's Capstone Design Project	3
ISE 712	Design of Experiments	3
ISE 742	Linear Programming and Extensions	3
ISE 757	Ergonomics and Occupational Biomechanics	3
ISE 763	Project Management Techniques	3
ISE 765	Advanced Production Systems	3
or ISE 764	Supply Chain Management	
Four additional graduate courses		12
<b>Total Credit Hours</b>		<b>163</b>

## Suggested Plan of Study

Freshman Year		Credit Hours
<b>Fall</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	Biomedical Design I	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	Biomedical Project I	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	Biomedical Design II	1
BME 340	Medical Instrumentation I	4
BME 370	Biomedical Signal Analysis	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	Biomedical Project II	2
BME 335	Biomaterials	3
BME 341	Medical Instrumentation II	3
BME 360	Applied Biotransport	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	Living Systems Engineering	3
BME 420	Capstone Project I	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	Capstone Project II	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>		
ISE 712	Design of Experiments	3
ISE 763	Project Management Techniques	3
ISE 742	Linear Programming and Extensions	3
<b>Credit Hours</b>		<b>9</b>
<b>Spring</b>		
ISE 757	Ergonomics and Occupational Biomechanics	3
ISE 764	Supply Chain Management	3
ISE 694	Master's Capstone Design Project	3
<b>Credit Hours</b>		<b>9</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 ISE course offerings.
- <sup>4</sup> Graduate courses are 600 or 700 level courses chosen from the ISE course offerings with the approval of the advisor.

## Suggested Plan of Study

### Pre-Med Track

<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>		
BIL 160	Evolution and Biodiversity	4
BIL 161	Evolution and Biodiversity Laboratory	1
BME 221	Biomedical Design I	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
<b>Credit Hours</b>		<b>17</b>
<b>Spring</b>		
BME 211	Introduction to Programming for Biomedical Engineers	3
BME 222	Biomedical Project I	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
<b>Credit Hours</b>		<b>17</b>
<b>Junior Year</b>		
<b>Fall</b>		
BMB 401	Biochemistry for the Biomedical Sciences	4
BME 265	Medical Systems Physiology	4
BME 310	Mathematical Analysis in Biomedical Engineering	3
BME 321	Biomedical Design II	1
CHM 206	Organic Reactions and Synthesis Laboratory	2
PHY 202	University Physics II for the Sciences	4
<b>Credit Hours</b>		<b>18</b>
<b>Spring</b>		
BME 312	Biomedical Statistics and Data Analysis	3
BME 322	Biomedical Project II	2
BME 335	Biomaterials	3
BME 340	Medical Instrumentation I	4
BME 370	Biomedical Signal Analysis	3
BME 375	Fundamentals of Biomechanics	3
<b>Credit Hours</b>		<b>18</b>
<b>Senior Year</b>		
<b>Fall</b>		
BME 336	Living Systems Engineering	3
BME 341	Medical Instrumentation II	3
BME 420	Capstone Project I	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	Applied Biotransport	3
BME 421	Capstone Project II	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>		
ISE 712	Design of Experiments	3
ISE 763	Project Management Techniques	3
ISE 742	Linear Programming and Extensions	3
Graduate Course		3
<b>Credit Hours</b>		<b>12</b>
<b>Spring</b>		
ISE 757	Ergonomics and Occupational Biomechanics	3
ISE 764	Supply Chain Management	3
ISE 694	Master's Capstone Design Project	3

Graduate Course <sup>2</sup>	3
<b>Credit Hours</b>	<b>12</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 ISE course offerings with the approval of the advisor.