

# MASTER OF BIOENGINEERING (MBE) DEGREE

## Program Learning Outcomes for the MBE Degree

### Program Learning Outcomes for the Applied Bioengineering Area of Specialization

Upon completing the MBE degree, students pursuing the Applied Bioengineering area of specialization requirements will be able to:

1. Apply and integrate advanced knowledge of Bioengineering topics in at least one of the following areas: Biomaterials, Tissue Engineering, Mechanobiology and Biophysics; Biomedical Imaging, Optics and Diagnostics; Microfabrication, Microfluidics and Design; Synthetic Biology and Genome Engineering; Quantitative, Computational and Theoretical Bioengineering.
2. Apply knowledge from engineering and other disciplines to identify, formulate, and solve novel and complex problems that require advanced knowledge in bioengineering.
3. Select and apply quantitative analytic techniques to analyze bioengineering data.

Additionally, upon completing the MBE degree, students pursuing the Applied Bioengineering area of specialization requirements *and the research option*, will be able to:

1. Develop practical experience of designing and performing laboratory research, including the ability to summarize and assess research results in a written format, and present research results.

### Program Learning Outcomes for the Global Medical Innovation Area of Specialization

Upon completing the MBE degree, students pursuing the Global Medical Innovation area of specialization requirements will be able to:

1. Apply knowledge of Bioengineering topics in at least one of the following areas: Biomaterials, Tissue Engineering, Mechanobiology and Biophysics; Biomedical Imaging, Optics and Diagnostics; Microfabrication, Microfluidics and Design; Synthetic Biology and Genome Engineering; Quantitative, Computational and Theoretical Bioengineering.
2. Develop effective medical products, from concept to commercialization, within a team environment.
3. Comprehend and navigate the global medical technology industry by leveraging an internship experience.

## Requirements for the MBE Degree

The MBE degree is a non-thesis master's degree. For general university requirements, please see [Non-Thesis Master's Degrees \(https://ga.rice.edu/graduate-students/academic-policies-procedures/regulations-procedures-non-thesis-masters-degrees/\)](https://ga.rice.edu/graduate-students/academic-policies-procedures/regulations-procedures-non-thesis-masters-degrees/). For additional requirements, regulations, and procedures for all graduate programs, please see [All Graduate Students \(https://ga.rice.edu/graduate-students/academic-policies-procedures/regulations-procedures-all-degrees/\)](https://ga.rice.edu/graduate-students/academic-policies-procedures/regulations-procedures-all-degrees/). Students pursuing the MBE degree must complete:

- A minimum of 30-31 credit hours, depending on area of specialization, to satisfy degree requirements.

- A minimum of 30 credit hours of graduate-level study (graduate semester credit hours, coursework at the 500-level or above).
- A minimum of 24 graduate semester credit hours must be taken at Rice University.
- A minimum of 24 graduate semester credit hours must be taken in standard or traditional courses (with a course type of lecture, seminar, laboratory, lecture/laboratory).
- A minimum residency enrollment of one fall or spring semester of part-time graduate study at Rice University.
- A maximum of 2 courses (6 graduate semester credit hours) from transfer credit. For additional departmental guidelines regarding transfer credit, see the *Policies* tab.
- The requirements for one area of specialization (see below for areas of specialization). The MBE degree program offers two areas of specialization:
  - **Applied Bioengineering** (class-only) or **Applied Bioengineering** (research option): designed as a flexible degree for students who will pursue careers in research, medicine, or related fields. This area of specialization of the MBE degree is designed for students to transition to medical school or a PhD program, or to advance their professional career in the biomedical industry **or**
  - **Global Medical Innovation**: designed specifically for students who will pursue a career in the global medical technology industry. This area of specialization of the MBE degree is designed to prepare engineers for careers in medical technology through education in innovation, emerging-market design projects and internships.
- A minimum overall GPA of 2.67 or higher in all Rice coursework.
- A minimum program GPA of 3.00 or higher in all Rice coursework that satisfies requirements for the non-thesis master's degree with a minimum grade of a B- (2.67 grade points) in each course (for the Applied Bioengineering area of specialization), **or** a minimum program GPA of 3.20 or higher in all Rice coursework that satisfies requirements for the non-thesis master's degree with a minimum grade of a B- (2.67 grade points) in each course (for the Global Medical Innovation area of specialization).

Both areas of specialization have the same prerequisites, though applicants will be evaluated considering the different purposes of each. More information about each of these areas of specialization can be found below. Curriculum must be approved by the Graduate Academic Affairs Committee and the Bioengineering Department. This is done on a case-by-case basis.

The Master of Bioengineering (MBE) degree is a professional non-thesis master's degree. Students who have a BS or BA degree in an engineering or science discipline may apply. Depending on their background, some students may need to take remedial engineering courses to earn the MBE degree. For more information, see the department website.

The courses listed below satisfy the requirements for this degree program. In certain instances, courses not on this official list may be substituted upon approval of the program's academic advisor, or where applicable, the department or program's Director of Graduate Studies. Course substitutions must be formally applied and entered into Degree Works by the department or program's [Official Certifier \(https://registrar.rice.edu/facstaff/degreeworks/officialcertifier/\)](https://registrar.rice.edu/facstaff/degreeworks/officialcertifier/). Additionally, these must be approved by the Office of Graduate and Postdoctoral

Studies. Students and their academic advisors should identify and clearly document the courses to be taken.

## Summary

Code	Title	Credit Hours
Total Credit Hours Required for the MBE Degree		30-31

## Degree Requirements

Code	Title	Credit Hours
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### Core Requirements

BIOE 627	MEDICAL INNOVATION INDUSTRY SEMINAR	1.5
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Select 1 course from the following: 1.5

BIOE 628	MEDICAL TECHNOLOGY DESIGN SEMINAR 2	
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BIOE 633 / MGMT 633	ROLES OF PHYSICIANS, SCIENTISTS, ENGINEERS AND MBA'S IN HIGH-TECH STARTUPS	
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### Area of Specialization

Select 1 of the following Areas of Specialization (see below for Areas of Specialization): 27-28

Applied Bioengineering (class-only or research option)	
Global Medical Innovation	

**Total Credit Hours** 30-31

## Areas of Specialization

### Area of Specialization: Applied Bioengineering (class-only)

Students pursuing the Applied Bioengineering (class-only) area of specialization must complete:

- A minimum of 2 courses (3 credit hours) from the core requirements.
- A minimum of 9 courses (27 credit hours) taken at the 500-level or above from selected course offerings.
  - A minimum of 6 courses (18 credit hours) from approved departmental (BIOE) course offerings.
  - A minimum of 1 course (3 credit hours) as a quantitative elective course.
  - A minimum of 1 course (3 credit hours) as a professional development elective course.
  - A minimum of 1 course (3 credit hours) from approved departmental (BIOE) course offerings or another department.
- A minimum program GPA of 3.00 or higher in all Rice coursework that satisfies requirements for the non-thesis master's degree with a minimum grade of a B- (2.67 grade points) in each course.

Code	Title	Credit Hours
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### Elective Requirements

Elective Category: BIOE Departmental Electives<sup>1,2</sup>

Select 6 courses from approved departmental (BIOE) course offerings at the 500-level or above 18

Elective Category: Quantitative Requirement

BIOE 539	APPLIED STATISTICS FOR BIOENGINEERING AND BIOTECHNOLOGY <sup>3</sup>	3
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Elective Category: Professional Development

Select a minimum of 3 credit hours from the following: 3

ENGI 501	WORKPLACE COMMUNICATION FOR PROFESSIONAL MASTER'S STUDENTS IN ENGINEERING
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ENGI 510	TECHNICAL AND MANAGERIAL COMMUNICATIONS
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ENGI 515	LEADING TEAMS AND INNOVATION
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ENGI 529 / CEVE 529	ETHICS AND ENGINEERING LEADERSHIP
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ENGI 542	PROFESSIONAL COMMUNICATION FOR ENGINEERING LEADERS
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ENGI 555	ENGINEERING PERSUASION: HOW TO DRIVE DECISIONS AND CHANGE
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ENGI 610	MANAGEMENT FOR SCIENCE AND ENGINEERING
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ENGI 615	LEADERSHIP COACHING FOR ENGINEERS
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UNIV 594	RESPONSIBLE CONDUCT OF RESEARCH
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Elective Category: BIOE General Elective

Select 1 additional course from approved departmental (BIOE) course offerings (or another department) at the 500-level or above 3

**Total Credit Hours** 27

## Footnotes and Additional Information

<sup>1</sup> Students may include up to 6 credit hours of BIOE 506 (*Graduate Independent Research*) within these 18 credit hours. Students choosing to complete the Applied Bioengineering area of specialization with the research option will take up to 9 credit hours of BIOE 507 and BIOE 607, which are more structured MBE research courses. For students taking BIOE 507 or BIOE 607, BIOE 506 may also be taken for additional research experience, but it will not be counted toward the 30 credit hours required for the MBE degree.

<sup>2</sup> For students formally admitted into and specifically pursuing the MBE/MD dual degrees program, up to 2 courses (6 credit hours) from the McGovern Medical School at the UT Health Science Center can fulfill MBE requirements: BIOE 695 *Transfer - Foundations of Medical Science* and BIOE 696 *Transfer - Doctoring 1: History and Physical Exam*.

<sup>3</sup> BIOE 539 or an alternative quantitative-based BIOE course, taken at the 500-level or above, with the advisor/MBE Program Director's approval.

### Area of Specialization: Applied Bioengineering (research option)

Students pursuing the Applied Bioengineering (research option) area of specialization must complete:

- A minimum of 2 courses (3 credit hours) from the core requirements.
- A minimum of 7 courses (19 credit hours) taken at the 500-level or above from selected course offerings.
  - A minimum of 4 courses (12 credit hours) from approved departmental (BIOE) course offerings.
  - A minimum of 1 course (3 credit hours) as a quantitative elective course.
  - A minimum of 1 course (3 credit hours) as a technical writing course.
  - A minimum of 1 course (1 credit hour) as an ethics course.
- A minimum of 2 courses (9 credit hours) from the research requirement.

- A minimum program GPA of 3.00 or higher in all Rice coursework that satisfies requirements for the non-thesis master's degree with a minimum grade of a B- (2.67 grade points) in each course.

- A minimum GPA of 3.20 or higher in all Rice coursework that satisfies requirements for the non-thesis master's degree with a minimum grade of a B- (2.67 grade points) in each course.

Code	Title	Credit Hours
<b>Elective Requirements</b>		
Elective Category: BIOE Departmental Electives <sup>1</sup>		
<i>Select 4 courses from approved departmental (BIOE) course offerings at the 500-level or above</i>		12
Elective Category: Quantitative Requirement		
BIOE 539	APPLIED STATISTICS FOR BIOENGINEERING AND BIOTECHNOLOGY <sup>2</sup>	3
Elective Category: Technical Writing		
<i>Select 1 course from the following:</i>		3
ENGI 501	WORKPLACE COMMUNICATION FOR PROFESSIONAL MASTER'S STUDENTS IN ENGINEERING	
ENGI 510	TECHNICAL AND MANAGERIAL COMMUNICATIONS	
ENGI 542	PROFESSIONAL COMMUNICATION FOR ENGINEERING LEADERS	
Elective Category: Ethics		
UNIV 594	RESPONSIBLE CONDUCT OF RESEARCH	1
<b>Research Requirement</b>		
BIOE 507	GRADUATE RESEARCH COMPONENTS I	3
BIOE 607	RESEARCH CONCENTRATION – COMPONENT II	6
<b>Total Credit Hours</b>		<b>28</b>

### Footnotes and Additional Information

<sup>1</sup> For students formally admitted into and specifically pursuing the MBE/MD dual degrees program, up to 2 courses (6 credit hours) from the McGovern Medical School at the UT Health Science Center can fulfill MBE requirements: BIOE 695 *Transfer - Foundations of Medical Science* and BIOE 696 *Transfer - Doctoring 1: History and Physical Exam*.

<sup>2</sup> BIOE 539 or an alternative quantitative-based BIOE course, taken at the 500-level or above, with the advisor/MBE Program Director's approval.

### Area of Specialization: Global Medical Innovation

Students pursuing the Global Medical Innovation area of specialization must complete:

- A minimum of 6 courses (15 credit hours) from the core requirements.
- An internship or independent study (6 credit hours).
- A minimum of 3 courses (9 credit hours) taken at the 500-level or above from selected course offerings.
  - A minimum of 1 course (3 credit hours) as a quantitative elective course.
  - A minimum of 1 course (3 credit hours) as a professional development elective course.
  - A minimum of 1 course (3 credit hours) from approved departmental (BIOE) course offerings or another department.

Code	Title	Credit Hours
<b>Core Requirements</b>		
Medical Technology Design		
BIOE 527	HEALTHCARE INNOVATION AND ENTREPRENEURSHIP	3
BIOE 529	HEALTHCARE INNOVATION AND ENTREPRENEURSHIP LAB	3
Medical Technology Implementation		
BIOE 528	MEDICAL ENGINEERING AND DESIGN LAB	3
BIOE 530	MEDICAL ENGINEERING & DESIGN LAB 2	3
<b>Internship or Independent Study <sup>1</sup></b>		
<i>Select 1 from the following:</i>		6
BIOE 506	GRADUATE INDEPENDENT STUDY (2 semesters required)	
BIOE 600	GRADUATE BIOENGINEERING INDUSTRY INTERNSHIP	
<b>Elective Requirements <sup>2</sup></b>		
Elective Category: Quantitative Requirement		
BIOE 539	APPLIED STATISTICS FOR BIOENGINEERING AND BIOTECHNOLOGY <sup>3</sup>	3
Elective Category: Professional Development		
<i>Select a minimum of 3 credit hours from the following:</i>		3
ENGI 501	WORKPLACE COMMUNICATION FOR PROFESSIONAL MASTER'S STUDENTS IN ENGINEERING	
ENGI 510	TECHNICAL AND MANAGERIAL COMMUNICATIONS	
ENGI 515	LEADING TEAMS AND INNOVATION	
ENGI 529 / CEVE 529	ETHICS AND ENGINEERING LEADERSHIP	
ENGI 542	PROFESSIONAL COMMUNICATION FOR ENGINEERING LEADERS	
ENGI 610 / NSCI 610	MANAGEMENT FOR SCIENCE AND ENGINEERING	
ENGI 615	LEADERSHIP COACHING FOR ENGINEERS	
Elective Category: BIOE General Elective		
<i>Select 1 additional course from approved departmental (BIOE) course offerings (or another department) at the 500-level or above <sup>4</sup></i>		3
<b>Total Credit Hours</b>		<b>27</b>

### Footnotes and Additional Information

<sup>1</sup> This will be considered on a case-by-case basis, and the student is responsible for obtaining and selecting an internship that best aligns with their career goals.

<sup>2</sup> For students formally admitted into and specifically pursuing the MBE/MD dual degrees program, up to 2 courses (6 credit hours) from the McGovern Medical School at the UT Health Science Center can fulfill MBE requirements: BIOE 695 *Transfer - Foundations of Medical Science* and BIOE 696 *Transfer - Doctoring 1: History and Physical Exam*.

- <sup>3</sup> BIOE 539 or an alternative quantitative-based BIOE course, taken at the 500-level or above, with the advisor/MBE Program Director's approval.
- <sup>4</sup> With advisor/MBE Program Director approval, students may complete a course offered by another department, outside of BIOE, but it must be relevant to the MBE degree.

## Policies for the MBE Degree

### Department of Bioengineering Graduate Program Handbook

The General Announcements (GA) is the official Rice curriculum. As an additional resource for students, the department of Bioengineering publishes a graduate program handbook, which can be found here: [https://gradhandbooks.rice.edu/2021\\_22/Bioengineering\\_Graduate\\_Handbook.pdf](https://gradhandbooks.rice.edu/2021_22/Bioengineering_Graduate_Handbook.pdf)

### Enrollment Status Requirements

Students may enroll for the Applied Bioengineering area of specialization on a full-time or part-time basis. For the Global Medical Innovation area of specialization, students may only enroll on a full-time basis. University graduation requirements (including the minimum residency requirement for students in graduate degree programs) all still apply.

### Transfer Credit

For Rice University's policy regarding transfer credit, see [Transfer Credit \(https://ga.rice.edu/graduate-students/academic-policies-procedures/regulations-procedures-all-degrees/#transfer\)](https://ga.rice.edu/graduate-students/academic-policies-procedures/regulations-procedures-all-degrees/#transfer). Some departments and programs have additional restrictions on transfer credit. Students are encouraged to meet with their academic program's advisor when considering transfer credit possibilities.

### Departmental Transfer Credit Guidelines

Students pursuing the MBE degree should be aware of the following departmental transfer credit guidelines:

- No more than 2 courses (6 credit hours) of transfer credit from U.S. or international universities of similar standing as Rice may apply towards the degree.
- Requests for transfer credit will be considered by the program director on an individual case-by-case basis.

### Additional Information

For additional information, please see the Bioengineering website: <https://bioengineering.rice.edu/>

## Opportunities for the MBE Degree

### Fifth-Year Master's Degree Option for Rice Undergraduate Students

In certain situations and with some terminal master's degree programs, Rice students have an option to pursue a master's degree by adding an additional fifth year to their four years of undergraduate studies.

Advanced Rice undergraduate students in good academic standing typically apply to the master's degree program during their junior or senior year. Upon acceptance, depending on course load, financial aid status, and other variables, they may then start taking some required courses of the master's degree program. A plan of study will need to be approved by the student's undergraduate major advisor and the master's degree program director.

As part of this option and opportunity, Rice undergraduate students:

- must complete the requirements for a bachelor's degree and the master's degree independently of each other (i.e. no course may be counted toward the fulfillment of both degrees).
- should be aware there could be financial aid implications if the conversion of undergraduate coursework to that of graduate level reduces their earned undergraduate credit for any semester below that of full-time status (12 credit hours).
- more information on this *Undergraduate - Graduate Concurrent Enrollment* opportunity, including specific information on the registration process can be found [here \(https://ga.rice.edu/undergraduate-students/academic-opportunities/undergraduate-graduate-concurrent-enrollment/\)](https://ga.rice.edu/undergraduate-students/academic-opportunities/undergraduate-graduate-concurrent-enrollment/).

Rice undergraduate students completing studies in science and engineering may have the option to pursue the Master of Bioengineering (MBE) degree. For additional information, students should contact their undergraduate major advisor and the MBE program director.

### Additional Information

For additional information, please see the Bioengineering website: <https://bioengineering.rice.edu/>