

# MASTER OF BIOENGINEERING (MBE) DEGREE / DOCTOR OF MEDICINE (MD) DEGREE WITH UT HEALTH SCIENCE CENTER

## Program Learning Outcomes for the MBE/MD Dual Degrees Program

### Program Learning Outcomes for the MBE Degree and a Major Concentration in Applied Bioengineering

Upon completing the MBE degree and a major concentration in Applied Bioengineering, students will be able to:

1. Apply and integrate advanced knowledge of Bioengineering topics in at least one of the following areas: Biomaterials, Biofabrication and Mechanobiology; Biomedical Imaging and Instrumentation; Cellular, Molecular, and Genome Engineering and Synthetic Biology; Computational and Theoretical Engineering and Biophysics.
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 and a major concentration in Applied Bioengineering, students pursuing that major concentration's optional *research* experience 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 MBE Degree and a Major Concentration in Global Medical Innovation

Upon completing the MBE degree and a major concentration in Global Medical Innovation, students will be able to:

1. Apply and integrate advanced knowledge of Bioengineering topics in at least one of the following areas: Biomaterials, Biofabrication and Mechanobiology; Biomedical Imaging and Instrumentation; Cellular, Molecular, and Genome Engineering and Synthetic Biology; Computational and Theoretical Engineering and Biophysics.
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/MD Dual Degrees Program

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 \(https://ga.rice.edu/graduate-students/\)](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 major concentration and course selection, 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.
- A minimum of 4 courses (12 credit hours) must be taken in departmental (BIOE) courses at Rice with a course type of lecture or lecture/laboratory.
- The requirements for one major concentration. When students apply to the MBE degree program, they must identify and be admitted into one of two major concentrations, either in:
  - **Applied Bioengineering (class-only) or Applied Bioengineering (research option):** designed as a flexible program for students who will pursue careers in research, medicine, or related fields. This MBE degree major concentration 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 MBE degree major concentration 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.

Both major concentrations have the same prerequisites, though applicants will be evaluated considering the different purposes of each. More information about each of these major concentrations 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/MD Dual Degrees Program		30-31

## Degree Requirements

Code	Title	Credit Hours
<b>Core Requirements</b>		
BIOE 627	MEDICAL INNOVATION INDUSTRY SEMINAR	1.5
BIOE 628	MEDICAL TECHNOLOGY DESIGN SEMINAR 2	1.5
<b>Major Concentration</b>		
Select 1 from the following Major Concentrations (see below for Major Concentration):		27-28
Applied Bioengineering (class-only or research option)		
Global Medical Innovation		
<b>Total Credit Hours</b>		<b>30-31</b>

### Major Concentration: Applied Bioengineering (class-only)

Students pursuing the MBE degree with an Applied Bioengineering (class-only) major concentration must complete:

Code	Title	Credit Hours
<b>Major Concentration Requirements: Applied Bioengineering (class-only)</b>		
<b>Elective Requirements</b>		
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		
Select a minimum of 3 credit hours from the following: <sup>3</sup>		3
BIOE 502 / BIOS 505 / SSPB 501	PHYSICAL BIOLOGY	
BIOE 539	APPLIED STATISTICS FOR BIOENGINEERING AND BIOTECHNOLOGY	
BIOE 541	CELL AND MOLECULAR BIOLOGY FOR ENGINEERS	
BIOE 552 / SSPB 502	INTRO COMPUTATIONAL SYSTEMS BIOLOGY: MODELING & DESIGN PRINCIPLES OF BIOCHEM NETWORKS	
BIOE 572	BIOMECHANICS	
RCEL 506	APPLIED STATISTICS AND DATA SCIENCE FOR ENGINEERING LEADERS	
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	

ENGI 510	TECHNICAL AND MANAGERIAL COMMUNICATIONS	
ENGI 515	LEADING TEAMS AND INNOVATION	
ENGI 529 / CEVE 529	ETHICS AND ENGINEERING LEADERSHIP	
ENGI 555	ENGINEERING PERSUASION: HOW TO DRIVE DECISIONS AND CHANGE	
ENGI 610 / NSCI 610	MANAGEMENT FOR SCIENCE AND ENGINEERING	
ENGI 615	LEADERSHIP COACHING FOR ENGINEERS	
RCEL 501	ENGINEERING MANAGEMENT & LEADERSHIP THEORY AND APPLICATION	
RCEL 502	ENGINEERING PROJECT MANAGEMENT	
RCEL 505	ENGINEERING ECONOMICS FOR ENGINEERING LEADERS	
RCEL 542	PROFESSIONAL COMMUNICATION FOR ENGINEERING LEADERS	
UNIV 594	RESPONSIBLE CONDUCT OF RESEARCH	
Elective Category: BIOE General Elective		
Select 1 additional course from approved departmental (BIOE) course offerings (or another department) at the 500-level or above <sup>4</sup>		3
<b>Total Credit Hours</b>		<b>27</b>

### Footnotes and Additional Information

- Students may include up to 6 credit hours of BIOE 506 (*Graduate Independent Research*) within these 18 credit hours. Students taking BIOE 506 must complete a minimum of 12 credit hours of BIOE lecture or lecture/lab coursework.
- 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*. These students must still complete a minimum of 12 credit hours of BIOE lecture or lecture/lab coursework.
- One of these courses or an alternative quantitative-based BIOE course, taken at the 500-level or above, with the advisor/MBE Program Director's approval.
- Students may complete a course offered by another department, but it must be relevant to the MBE degree.

### Major Concentration: Applied Bioengineering (optional research experience)

Students pursuing the MBE degree with an Applied Bioengineering major concentration (optional *research* experience) must complete:

Code	Title	Credit Hours
<b>Major Concentration Requirements: Applied Bioengineering (optional research experience)</b>		
<b>Elective Requirements</b>		
Elective Category: BIOE Departmental Electives <sup>1</sup>		
Select 4 courses from approved departmental (BIOE) course offerings at the 500-level or above		12
Elective Category: Quantitative Requirement		
Select 1 course from the following: <sup>2</sup>		3

BIOE 502 / BIOS 505 / SSPB 501	PHYSICAL BIOLOGY	
BIOE 539	APPLIED STATISTICS FOR BIOENGINEERING AND BIOTECHNOLOGY	
BIOE 541	CELL AND MOLECULAR BIOLOGY FOR ENGINEERS	
BIOE 552 / SSPB 502	INTRO COMPUTATIONAL SYSTEMS BIOLOGY: MODELING & DESIGN PRINCIPLES OF BIOCHEM NETWORKS	
BIOE 572	BIOMECHANICS	
RCEL 506	APPLIED STATISTICS AND DATA SCIENCE FOR ENGINEERING LEADERS	
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	
RCEL 542	PROFESSIONAL COMMUNICATION FOR ENGINEERING LEADERS	
Elective Category: Ethics		
UNIV 594	RESPONSIBLE CONDUCT OF RESEARCH	1
<b>Research Requirement<sup>3</sup></b>		
BIOE 507	GRADUATE RESEARCH COMPONENTS I	2
BIOE 511	MBE RESEARCH DESIGN AND TECHNOLOGY SEMINAR	2
BIOE 607	RESEARCH CONCENTRATION – COMPONENT II	5
<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*. These students must still complete a minimum of 12 credit hours of BIOE lecture or lecture/lab coursework.

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

<sup>3</sup> Students choosing to complete the Applied Bioengineering Major Concentration (optional research experience) will take up to 9 credit hours of BIOE 507, BIOE 511, and BIOE 607, which is a structured sequence of MBE research and research seminar 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 31 credit hours required for the MBE. The rare exception will be if BIOE 506 is taken as an internship, with the MBE Director permission, at another institution (academic, clinical or industry). This exception will be allowed under 2 conditions: (1) a Rice BIOE faculty member will be designated as the supervisor for course credit and will receive biweekly progress reports; and (2) an equivalent number of additional credit hours must be taken through BIOE lecture or lecture/lab coursework at Rice. This arrangement will ensure that students meet the requirement of a minimum 12 credit hours of BIOE lecture or lecture/lab coursework.

**Major Concentration: Global Medical Innovation**

Students pursuing the MBE degree with a Global Medical Innovation major concentration must complete:

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		
<i>Select a minimum of 3 credit hours from the following:</i> <sup>3</sup>		3
BIOE 502 / BIOS 505 / SSPB 501	PHYSICAL BIOLOGY	
BIOE 539	APPLIED STATISTICS FOR BIOENGINEERING AND BIOTECHNOLOGY <sup>3</sup>	
BIOE 541	CELL AND MOLECULAR BIOLOGY FOR ENGINEERS	
BIOE 552 / SSPB 502	INTRO COMPUTATIONAL SYSTEMS BIOLOGY: MODELING & DESIGN PRINCIPLES OF BIOCHEM NETWORKS	
BIOE 572	BIOMECHANICS	
RCEL 506	APPLIED STATISTICS AND DATA SCIENCE FOR ENGINEERING LEADERS	
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 555	ENGINEERING PERSUASION: HOW TO DRIVE DECISIONS AND CHANGE	
ENGI 610 / NSCI 610	MANAGEMENT FOR SCIENCE AND ENGINEERING	
ENGI 615	LEADERSHIP COACHING FOR ENGINEERS	
RCEL 501	ENGINEERING MANAGEMENT & LEADERSHIP THEORY AND APPLICATION	
RCEL 502	ENGINEERING PROJECT MANAGEMENT	
RCEL 505	ENGINEERING ECONOMICS FOR ENGINEERING LEADERS	
RCEL 542	PROFESSIONAL COMMUNICATION FOR ENGINEERING LEADERS	
UNIV 594	RESPONSIBLE CONDUCT OF RESEARCH	
Elective Category: BIOE General Elective		
Select 1 additional course from approved departmental (BIOE) course offerings (or another department) at the 500-level or above <sup>4</sup>		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. Students typically take BIOE 506 *Graduate Independent Study* for 2 semesters (3 credit hours each for 6 credit hours total), or 1 semester of BIOE 600 *Graduate Bioengineering Industry Internship* for 6 credit hours.
- <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> Students may complete a course offered by another department, but it must be relevant to the MBE degree.

## Policies for the MBE/MD Dual Degrees Program

### 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/2023\\_24/Bioengineering\\_Graduate\\_Handbook.pdf](https://gradhandbooks.rice.edu/2023_24/Bioengineering_Graduate_Handbook.pdf)

### Enrollment Status Requirements

Students may enroll for the MBE Degree with a Major Concentration in Applied Bioengineering (*class-only* or optional *research* experience) on a full-time or part-time basis. For the MBE Degree with a Major Concentration in Global Medical Innovation, 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/MD Dual Degrees Program

### Additional Information

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