BIOENGINEERING (MS)

Master of Science in Bioengineering
Unit: Speed School of Engineering (https://engineering.louisville.edu/)
Department: Bioengineering (https://engineering.louisville.edu/ bioengineering/)
Program Website (https://engineering.louisville.edu/graduatedegrees/)
Academic Plan Code: BE_ _MS

Program Information

General Information
The Master of Science in Bioengineering program offers advanced-level training that provides students with in-depth knowledge of bioengineering in areas such as biocomputational modeling, bioimaging, bioinstrumentation, biomaterials, biomechanics, biomedical devices, bioMEMS, bionanotechnology, biosensors, biosignal processing, biosystems control, molecular bioengineering, and tissue engineering. Student educational experiences are enhanced by research opportunities in laboratories conducting basic and translational research on oncology, cardiovascular disease, nanotherapeutics, orthopedics, drug delivery, injury, tissue regeneration and image-based diagnostics.

The Master of Science (MS) degree program is intended for persons having an accredited baccalaureate degree in bioengineering, but is also available to those with other backgrounds. Applicants with other backgrounds should expect to take some undergraduate background coursework. Students interested in the MS degree program should consult the Director of Graduate Studies in the Department of Bioengineering.

The Master of Science in Bioengineering program objectives are to:

a. Train highly motivated graduate students who demonstrate advanced level bioengineering expertise and practical engineering experience necessary to function as bioengineering professionals.

b. Develop students with the bioengineering expertise and practical experience necessary for employment in industry, academia or government, or further professional/graduate studies.

Academic Performance
The J.B. Speed School of Engineering has established the following performance policies:

a. The minimum grade point average requirement for good standing and satisfaction of degree requirements is 3.00 for all academic work completed while in graduate studies.

b. Any student who does not satisfy the published performance criteria shall be placed in probationary status. Please review the Academic Standing Section (https://catalog.louisville.edu/graduate/general-policies-procedures-requirements/) within this catalog in regard to Academic Probation.

c. Students who fail to meet performance goals or who do not meet other requirements as outlined in the admission letter, program requirements or the university catalog may be subject to academic dismissal from their programs. All degree requirements must be completed within six years from admission into the program.

All graduate students are expected to make steady and satisfactory progress toward the completion of degrees. Students who are not enrolled for a period of more than 12 months will be considered to have withdrawn from the program. Students who seek to return after such a period of time must contact the graduate program director.

The Bioengineering department has established the following grading policy for the Master of Science in Bioengineering program:

1. A student cannot receive a C+ or lower grade in courses counting towards the Bioengineering Master’s of Science Program. The program Director must be made aware of any coursework in which a grade of C+ or lower was received.

Degree Requirements
The following degree requirements are mandatory for all Master of Science candidates:

a. The program of study must be completed with a 3.00 GPA or better for all graduate courses used to satisfy degree requirements. Additionally, the program of study must be completed with a 3.00 GPA or better for all academic work attempted in graduate studies.

b. Master’s students must take at least 24 credit hours of coursework at the University of Louisville to satisfy the residency requirement for the master’s degree. A maximum of six (6) credit hours of graduate credit may be transferred from accredited institutions.


d. Student has six years after their admission to the MS program to complete their degree.

The requirements for the Master of Science degree are discussed in more detail in the Degree Requirements (https://catalog.louisville.edu/graduate/general-policies-procedures-requirements/degree-requirements/) section of this catalog.

Admission Standards
The admission standards for the Master of Science program in Bioengineering are as follows:

a. All admission applications for the program shall include:
   i. A completed application for admission (http://louisville.edu/graduate/apply/) for the Graduate School,
   ii. An application fee,
   iii. At least two letters of recommendation,
   iv. Written statement describing previous experience related to Bioengineering and how the Master of Science in Bioengineering will allow the applicant to fulfill their career goals, and
   v. Official transcript(s) for all previous post-secondary coursework. All transcripts not in English must be certified as authentic and translated verbatim into English.

b. The minimum requirement for admission is the baccalaureate degree or its equivalent from an accredited institution.

c. The successful applicant will typically have an undergraduate grade point average of 3.00 or above (on a 4.00 scale).

d. International students whose primary language is not English must show English language proficiency by either TOEFL/IELTS/Duolingo score or demonstration of a degree awarded from an acceptable English language institution. The successful applicant will typically have a TOEFL score of 79 or higher or overall IELTS score of 6.5 or higher or a Duolingo score of 105 or higher.
Degree Requirements

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<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td><strong>Program Core</strong></td>
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<tr>
<td>BE 601</td>
<td>Bioengineering Seminar (two)</td>
<td>2</td>
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<tr>
<td>BE 621</td>
<td>Bioinstrumentation</td>
<td>4</td>
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<tr>
<td>BE 654</td>
<td>Advanced Physiology for Engineers</td>
<td>3</td>
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<tr>
<td>BE 695</td>
<td>Bioengineering Research Design &amp; Methods</td>
<td>3</td>
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<tr>
<td>CHE 686</td>
<td>Chemical Engineering Analysis</td>
<td>3</td>
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<tr>
<td></td>
<td><strong>Technical Electives</strong></td>
<td>9-12</td>
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<td></td>
<td>See below for areas of emphasis and approved courses</td>
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<td></td>
<td><strong>Thesis or Project</strong></td>
<td>3-6</td>
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<tr>
<td>BE 698</td>
<td>Master of Science Thesis in Bioengineering</td>
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<tr>
<td>or BE 691</td>
<td>Bioengineering Non-thesis Design/Research Project</td>
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Minimum Total Hours 30

The Master of Science degree must be completed with a 3.00 GPA or better for all graduate courses used to satisfy degree requirements and all academic work attempted in graduate studies.

1 Thesis option students complete nine (9) credit hours of emphasis-area coursework; non-thesis option students complete twelve (12) credit hours of emphasis-area coursework.

2 Thesis option students complete six (6) credit hours of BE 698 Master of Science Thesis in Bioengineering; non-thesis option students complete three (3) credit hours of BE 691 Bioengineering Non-thesis Design/Research Project.

3 Students in the MS in BE program interested in continuing their graduate studies in the Bioengineering PhD program must reach out to the MS in BE program Director during their first semester.

Technical Electives

Thesis option students complete nine (9) credit hours of technical electives in the emphasis areas listed below. Non-thesis/project option students complete twelve (12) credit hours of technical electives.

Students may take technical electives from more than one area of emphasis with prior approval from the student’s advisor and the Department Chair.

Technical electives must include at least nine (9) credit hours of Bioengineering (BE-prefix courses), unless a student’s advisor and the Department Chair approve a deviation from this requirement.

Fulfillment of technical elective requirements with courses outside of the emphasis-area electives require permission from the student’s advisor and Department Chair.

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<th>Code</th>
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<tr>
<td></td>
<td><strong>Bioelectrical &amp; Biomedical Devices</strong></td>
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<td>BE 522</td>
<td>Biomedical Acoustics</td>
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<td>BE 524</td>
<td>LabVIEW for Bioengineers</td>
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<td>BE 581</td>
<td>Advanced Computer-Aided Design and Manufacturing for Bioengineers</td>
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<td>BE 611</td>
<td>Cardiovascular Dynamics</td>
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<td>BE 650</td>
<td>Advanced Biomaterials</td>
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<td>BE 683</td>
<td>Artificial Organs</td>
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<tr>
<td>ECE 543</td>
<td>Fundamentals of Microfabrication and MEMS</td>
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Bioimaging & Biocomputational Modeling

BE 530 Machine Learning in Python
BE 540 Machine Learning in Medicine
BE 542 Medical Image Computing
BE 543 Computer Tools for Medical Image Analysis
BE 544 Artificial Intelligence Techniques in Digital Pathology
BE 604 Introduction to Artificial Intelligence in Bioengineering
BE 640 Computational Methods for Medical Image Analysis
BE 685 Modeling of Biological Phenomena
CSE 622 Simulation and Modeling of Discrete Systems
CSE 627 Digital Image Processing
CSE/ECE 641 Medical Imaging Systems
CSE 660 Introduction to Bioinformatics
ECE 643 Introduction to Biomedical Computing

Biomechanics & Rehabilitation

BE 581 Advanced Computer-Aided Design and Manufacturing for Bioengineers
BE 611 Cardiovascular Dynamics
BE 630 Biomechanical Computer Modeling and Simulation of Human Movement
BE 639 Injury Biomechanics
BE 658 Rehabilitation Engineering and Assistive Technology
BE 670 Cellular Mechanobiology in Cancer

Molecular & Tissue Engineering

BE 552 Introduction to Tissue Engineering
BE 553 Nanoscale Bioengineering: Application and Methodology of Nanobiomaterials in Bioengineering
BE 605 Tissue and Molecular Biology Techniques Laboratory
BE 650 Advanced Biomaterials
BE 670 Cellular Mechanobiology in Cancer
BIOC 680 Biomolecular Interactions
BIOC 668 Molecular Biology
BIOC 611 Techniques in Biomolecular Interactions