

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 University of Louisville is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools to award master's degrees.

The Master of Science in Bioengineering program objectives are to:

1. Train highly motivated graduate students who demonstrate advanced level bioengineering expertise and practical engineering experience necessary to function as bioengineering professionals. (*Advanced Knowledge and Life-long Learning*)
2. Develop students with the bioengineering expertise and practical experience necessary for employment in industry, academia or government, or further professional/graduate studies. (*Career Opportunities*)
3. Develop students with an understanding of the broad, social, ethical and professional issues of contemporary engineering practice. (*Awareness and Responsibility*)

Academic Performance

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

1. 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.
2. 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.
3. 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.

Degree Requirements

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

1. 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.
2. 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.
3. Students following the Thesis Option must follow the Guidelines for the Preparation of a Thesis or Dissertation [pdf] (<http://louisville.edu/graduate/current-students/thesis-dissertation-information/thesis-dissertation-guidelines-1/>)
4. 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:

1. All admission applications for the program shall include:
 - a. A completed application for admission (<http://louisville.edu/graduate/apply/>) for the Graduate School,
 - b. An application fee,
 - c. At least two letters of recommendation,
 - d. 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
 - e. Official transcript(s) for all previous post-secondary coursework. All transcripts not in English must be certified as authentic and translated verbatim into English.
2. The minimum requirement for admission is the baccalaureate degree or its equivalent from an accredited institution.
3. The successful applicant will typically have an undergraduate grade point average of 3.00 or above (on a 4.00 scale).
4. 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 80 or higher or overall IELTS score of 6.5 or higher or a Duolingo score of 105 or higher.

1.

Degree Requirements

Code	Title	Hours
Program Core		
BE 601	Bioengineering Seminar (two)	2
BE 621	Bioinstrumentation	4
BE 654	Advanced Physiology for Engineers	3
BE 695	Bioengineering Research Design & Methods	3
CHE 686	Chemical Engineering Analysis	3
Technical Electives ¹		9-12
See below for areas of emphasis and approved courses ¹		
Thesis or Project ²		3-6
BE 698	Master of Science Thesis in Bioengineering	
or BE 691	Bioengineering Non-thesis Design/Research Project	
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.

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.

Code	Title	Hours
Bioelectrical & Biomedical Devices		
BE 522	Biomedical Acoustics	
BE 524	LabVIEW for Bioengineers	
BE 581	Advanced Computer-Aided Design and Manufacturing for Bioengineers	
BE 611	Cardiovascular Dynamics	
BE 650	Advanced Biomaterials	
BE 683	Artificial Organs	
ECE 543	Fundamentals of Microfabrication and MEMS	
Bioimaging & Biocomputational Modeling		

BE 500	Special Topics in Bioengineering (AI Techniques in Digital Photography)
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 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