Governed Master’s Students in the Department of Biomedical Engineering 2017-2018
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Bulletin
For clarification about University policies concerning master’s degrees in the School of Engineering and Applied Science, please see the relevant University Bulletin at http://bulletin.wustl.edu/grad/Bulletin_2017-18_grad_engineering.pdf.

Admissions Deadlines

Application Submission
- MS - Entering in Fall: March 1
- MS - Entering in Spring: October 1
- BS/MS: September 1
- MEng: January 15

Enrollment Decision
- MS - Entering in Fall: May 15
- MS - Entering in Spring: November 1
- BS/MS: May 15
- MEng: March 15

Registration & Advising

Registration takes place each semester on dates announced by the University. Detailed instructions for registration plus necessary materials are mailed directly to all graduate students enrolled during the previous semester.

All master’s students in the department must register each semester until all degree requirements are completed. The master’s degrees must be completed within six years from the time the student is admitted to graduate standing.

Full-time: 9 credits or more
Normally students register in this category until they have earned the total number of credit hours required for their degree. Master’s students register for 9 hours of courses and/or research each semester until 30 hours are completed.
Part-time: 1-8 credits. This option is typically not available for international students. The one exception is if the student is in the final semester and his/her F-1 Application for a Reduced Course Load is approved by the Office of International Students and Scholars (OISS).

Inactive: Students who have not completed their course requirements but who, because of personal reasons, must suspend their studies temporarily may register as inactive students with the approval of their advisor, the Director of Master’s Studies. Not available for international students.

Academic Advisor: Each entering master’s student will be assigned an academic advisor by the Director of Master’s Studies. This advisor will be a full-time faculty member in the Department of Biomedical Engineering and will be responsible for acquainting the student with degree requirements.

Academic Performance

Master's students must maintain a cumulative grade point average of at least 2.70. Academic probation occurs if a semester or cumulative grade point average drops below 2.70. A master's student is eligible for academic suspension if any one of the follow occurs. The student

- receives an F grade in a course, or
- earns a semester or cumulative grade point average less than 2.00, or
- has been on probation for two semesters and has not attained a 2.70 cumulative grade point average.

Academic Integrity

All students in the School of Engineering & Applied Science are expected to conform to high standards of conduct. This statement on student academic integrity is intended to provide guidelines on academic behaviors that are not acceptable. Please visit the Engineering Student Services website for examples of violations and a link to the University-wide policy: [http://engineering.wustl.edu/current-students/student-services/Pages/academic-integrity-policy.aspx](http://engineering.wustl.edu/current-students/student-services/Pages/academic-integrity-policy.aspx)
INDEPENDENT STUDY
A maximum of 3 credits of independent study (BME 500 or BME 5799) may be counted toward a master’s degree. Registration for independent study requires approval by the Director of Master’s Studies. MS students pursuing a thesis should not plan to register for independent study.

DEADLINES
Graduation requirements must be fulfilled and forms submitted prior to deadlines established by the School and University. Current dates can be found at https://engineering.wustl.edu/current-students/student-services/Pages/Academic-Calendar.aspx.

MASTER OF SCIENCE PROGRAMS

REQUIREMENTS
A maximum of six units of graduate credit obtained at institutions other than Washington University may be applied toward the MS degree awarded by Engineering. Transfer credit must be recommended and approved by the Director of Master’s Studies as well as by the Engineering Registrar. No courses carrying grades lower than B can be accepted for transfer credit. Up to two 400-level courses may be counted toward the 30 credits of graduate coursework required for the MS (but not including independent study courses, journal clubs or seminar-based courses).

Two options exist for the Master of Science (MS) degree, thesis and non-thesis:

Thesis option: For this option, a minimum of 24 credits of coursework is required, with the balance being thesis research. The courses must fulfill the core curriculum requirement (see the “Course Selection” section). The remainder of the coursework is generally driven by the student’s research interest. Students must declare the thesis option before the second semester of MS studies begins.

Registration & Requirements for Thesis: Thesis students must register for E62 BME 599 Master’s Research with the section of the intended thesis mentor at least twice, one each semester s/he conducts research (up to 6 credits).
Every semester a student intends to register for E62 BME 599 Master’s Research:

- s/he must submit to the Director of Master’s Studies an updated Title, Scope and Procedure form, found on the BME website. The Director must approve this form before this course registration will be allowed.

- the thesis mentor of the student must assign a midterm grade for this course, so students know they are making suitable progress toward a thesis prior to the withdrawal deadline of the course. Grades will reflect research performance.

A grade of B- or higher must be obtained for at least 6 credits of this course in order to graduate with the thesis option. These grades are assigned by the thesis mentor. Important note: failure to complete a thesis in the indicated lab would lead to a failing grade in one or more of these courses.

**Thesis Committee**: Students preparing a thesis for the Master of Science will have a three-member thesis committee appointed by the Director of Master’s Studies and headed by the research mentor. This committee will be responsible for hearing, critiquing and approving the student’s thesis. The structure of the Master’s Thesis Committee should be as follows:

1. At least three faculty approved by the Director
2. The committee chair is the thesis advisor. This person must be identified and approved by the Director the first time a student submits the Title, Scope and Procedure form.
3. At least one member of the committee must be a primary or affiliate faculty member of BME.
4. Committee membership must be determined no later than the second time a student submits the Title, Scope and Procedure form. Approval of this second form by the Director is indication that the student is free to plan the thesis defense. Discussion with the thesis mentor and the Director is encouraged in order to select appropriate committee members.

Students are encouraged to establish their committees and schedule their thesis defenses early; the deadlines for finalizing a committee are as follows:

- October 31 for December graduates
- March 31 for May graduates
- June 30 for August graduates
Upon completion of the thesis, the candidate must pass an oral defense conducted by his/her thesis committee. This will consist of a public presentation followed by questions from the committee. Candidates must have a cumulative grade point average of 2.7 or better to receive the degree.

**Non-thesis (Course) option:** Candidates must accumulate a total of 30 graduate credits, have a cumulative grade point average of 2.7 or better, and satisfy the core curriculum requirements. The balance of the course credits should be selected with a view toward coherence reflecting a specialization in a research area.

**Seminars**

Each year the department sponsors or participates in a series of seminars by visiting lecturers and Washington University faculty and students. All MS students are required to enroll in E62 BME 501 Graduate Seminar, which is a pass/fail course carrying no credit, for a minimum of 2 semesters. A passing grade is required for each semester and is earned by regular attendance at these events. The number of required seminars is determined each semester but will not be fewer than 10 or more than 1 per week.

**Course Selection**

MS students formulate their course program in consultation with their academic advisor. The core curriculum to be completed by MS students requires the following minimum course distribution from the approved lists:

- 2 graduate courses (6 credits) in the area of life sciences
- 1 graduate course (3 credits) in the area of mathematics
- 1 graduate course (3 credits) in the area of computer science
- 3 elective graduate courses

Other than E62 BME 501 Graduate Seminar, no courses taken pass/fail will count toward the degree.

**Educational Programs and Constituent Courses**

Current as of [SummerSpring, 2017-2018](#). For the most up-to-date information, please contact the Director.
COURSES THAT FULFILL ELECTIVE GRADUATE COURSES:

General Biomedical Engineering
BME 5771 Biomedical Product Development
BME 5772 Biomedical Business Development

Biomaterials & Tissue Engineering
BME 523 Biomaterial Science
BME 524 Tissue Engineering
BME 559 Intermediate Biomechanics
BME 564 Orthopedic Biomechanics - Cartilage/Tendon
BME 565 Biosolid Mechanics
MEMS 5560 Interfaces and Attachments in Natural and Engineered Structures
BME 5565 Mechanobiology of Cells and Matrices
MEMS 5566 Engineering Mechanobiology
MEMS 5606 Soft Nanomaterials
MEMS 5608 Introduction to Polymer Science & Engineering

Cardiovascular Engineering
BME 562 Mechanics of Growth and Development
BME 574 Quantitative Bioelectricity and Cardiac Excitation
BME 575 Molecular Basis of Bioelectrical Excitation
BME 5901 Integrative Cardiac Electrophysiology

Imaging
BME 507 Radiological Physics and Dosimetry
BME 5072 Radiation Oncology Physics
BME 589 Biological Imaging Technology
BME 5820 Fundamentals and Applications of Modern Optical Imaging
BME 5907 Advanced Concepts in Image Science
BME 593 Computational Methods for Inverse Problems
BME 594 Ultrasound Imaging
BIOL 5146 Principles and Applications of Biological Imaging
CSE 568M Imaging Sensors
ESE 438 Applied Optics
ESE 588 Quantitative Image Processing
PSYCH 4450 Functional Neuroimaging Methods

Molecular, Cellular, and Systems Engineering
BME 537 Computational Molecular Biology
BME 5610 Protein Structures and Dynamics
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME 5903</td>
<td>Physical Methods for Biomedical Scientists</td>
</tr>
<tr>
<td>BME 5913</td>
<td>Molecular Systems Biology: Computation &amp; Measurements for Understanding Cell Physiology and Disease</td>
</tr>
<tr>
<td>BIOL 5311</td>
<td>Dynamics in Mesoscopic Molecular Systems</td>
</tr>
<tr>
<td>BIOL 5312</td>
<td>Macromolecular Interactions</td>
</tr>
</tbody>
</table>

**Neural Engineering**
- BME 471   Bioelectric Phenomena
- BME 533   Biomedical Signal Processing
- BME 572   Biological Neural Computation
- ESE 546   Dynamics & Control in Neuroscience

**Courses That Fulfill:**

**Life Sciences requirement**
- BME 530A  Molecular Cell Biology for Engineers
- BME 503A  Cell & Organ Systems
- BME 538   Cell Signal Transduction
- BME 5071  Radiobiology
- BME 5902  Cellular Neurophysiology
- BME 5909  Physiology of the Heart
- BIOL 4071 Developmental Biology *(4CR)*
- BIOL 4580 Principles of Human Anatomy & Development
- BIOL 4810 General Biochemistry I
- BIOL 4820 General Biochemistry II
- BIOL 5068 Fundamentals of Molecular Cell Biology
- BIOL 5051 Foundations in Immunology *(4Cr)*
- BIOL 5053 Immunobiology *(4Cr)*
- BIOL 5062 Central Questions in Cell Biology
- BIOL 5224 Molecular, Cell, and Organ Systems
- BIOL 5285 Fundamentals of Mammalian Genetics
- BIOL 5319 Molecular Foundations of Medicine
- BIOL 5352 Developmental Biology
- BIOL 5357 Chemistry and Physics of Biomolecules
- BIOL 5488 Genomics *(4CR)*
- BIOL 5571 Cellular Neurobiology *(4Cr)*
- BIOL 5651 Neural Systems
- BIOL 404 Laboratory of Neurophysiology
- BIOL 548 Nucleic Acids and Protein Biosynthesis
- BIOL 5663 Neurobiology of Disease

**Mathematics requirement**
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>BME 5912</td>
<td>Applied Mathematics for Biomedical Sciences</td>
</tr>
<tr>
<td>BME 593</td>
<td>Computational Methods for Inverse Problems</td>
</tr>
<tr>
<td>ESE 501</td>
<td>Mathematics of Modern Eng. I</td>
</tr>
<tr>
<td>ESE 502</td>
<td>Mathematics of Modern Eng. II</td>
</tr>
<tr>
<td>ESE 517</td>
<td>Partial Differential Equations</td>
</tr>
<tr>
<td>ESE 520</td>
<td>Probability and Stochastic Processes</td>
</tr>
<tr>
<td>MATH 449</td>
<td>Numerical Applied Mathematics</td>
</tr>
<tr>
<td>PHY 501</td>
<td>Methods of Theoretical Physics I</td>
</tr>
<tr>
<td>PHY 502</td>
<td>Methods of Theoretical Physics II</td>
</tr>
<tr>
<td>PHY 503</td>
<td>Advanced Math Methods for Physicist &amp; Eng. I</td>
</tr>
<tr>
<td>PHY 504</td>
<td>Advanced Math Methods for Physicist &amp; Eng. II</td>
</tr>
</tbody>
</table>

**Computer Science requirement**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>BME 550</td>
<td>Numerical Methods for Computational Modeling in</td>
</tr>
<tr>
<td></td>
<td>Biomedicine</td>
</tr>
<tr>
<td>BME 5913</td>
<td>Molecular Systems Biology: Computation &amp;</td>
</tr>
<tr>
<td></td>
<td>Measurements for Understanding Cell Physiology</td>
</tr>
<tr>
<td></td>
<td>and Disease</td>
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<tr>
<td>CSE 501N</td>
<td>Programming Concepts and Practice</td>
</tr>
<tr>
<td>CSE 502N</td>
<td>Fundamentals of Computer Science</td>
</tr>
<tr>
<td>CSE 503S</td>
<td>Rapid Prototype Development and Creative</td>
</tr>
<tr>
<td></td>
<td>Programming</td>
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<tr>
<td>CSE 504N</td>
<td>Object-oriented Software Development Lab</td>
</tr>
<tr>
<td>CSE 511A</td>
<td>Introduction to Artificial Intelligence</td>
</tr>
<tr>
<td>CSE 515T</td>
<td>Bayesian Methods in Machine Learning</td>
</tr>
<tr>
<td>CSE 517A</td>
<td>Machine Learning</td>
</tr>
<tr>
<td>CSE 543T</td>
<td>Algorithms for Nonlinear Optimization</td>
</tr>
<tr>
<td>CSE 554A</td>
<td>Geometric Computing for Biomedicine</td>
</tr>
<tr>
<td>CSE 555A</td>
<td>Computational Photography</td>
</tr>
<tr>
<td>CSE 559A</td>
<td>Computer Vision</td>
</tr>
<tr>
<td>CSE 541T</td>
<td>Advanced Algorithms</td>
</tr>
<tr>
<td>MEMS 5515</td>
<td>Numerical Simulation in Solid Mechanics I</td>
</tr>
</tbody>
</table>

Some courses fall into multiple categories but can only be used to fulfill a single degree requirement.

Additional courses may fulfill the life science, mathematics or computer science requirements, dependent upon your background and at the discretion of the Director of Master’s Studies. All courses outside of SEAS other than those listed above require approval of the Director.
BACHELOR'S/MASTER’S (BS/MS) ADDITIONAL INFORMATION

BS/MS students may transfer 6 credits of shared coursework from their BS toward the MS upon the approval of the Director of Master’s Studies. These transfer/shared credits must be determined at the first advising session and be sent to the registrar’s office for notification and approval.

MASTER OF ENGINEERING IN BIOMEDICAL INNOVATION (MENG-BMI)

The MEng-BMI is a 12-month intensive, hands-on program for students seeking to hone their engineering skills and acquire the entrepreneurial skills necessary to convert great ideas into products that benefit people. This professional training program allows students to develop a well-rounded skillset comparable to engineers with multiple years of healthcare industry experience.

REQUIREMENTS

Students are required to take the core curriculum courses. Only 6 of the 30 graduate course credits may be transferred from another university and are subject to approval by the Director of Master’s Studies. Only the MEng-BMI electives can be satisfied in this manner. Students in the MEng-BMI program must maintain the School’s minimum cumulative GPA of 2.7, which is a B– average.

Core Curriculum – 24 CR
<table>
<thead>
<tr>
<th>Section</th>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.01</td>
<td>MER</td>
<td>7Cr</td>
<td>Section 1.03 Mastery of Engineering Skills for Biomedical Innovators – 3Cr</td>
</tr>
<tr>
<td>1.02</td>
<td>BM</td>
<td>5701</td>
<td>Section 1.05 Ideation of Biomedical Problems and Solutions – 3Cr</td>
</tr>
<tr>
<td>1.03</td>
<td>BM</td>
<td>5711</td>
<td>Section 1.07 Analysis of Biomedical Market Needs – 1Cr</td>
</tr>
<tr>
<td>1.04</td>
<td>BM</td>
<td>5721</td>
<td>Section 1.10 Application of Advanced Engineering Skills for Biomedical Innovators – 3Cr</td>
</tr>
<tr>
<td>1.05</td>
<td>FAI</td>
<td>10Cr</td>
<td>Section 1.12 Implementation of Biomedical Solutions – 3Cr</td>
</tr>
<tr>
<td>1.06</td>
<td>BM</td>
<td>5702</td>
<td>Section 1.14 Feasibility Evaluation of Biomedical Products – 3Cr</td>
</tr>
<tr>
<td>1.07</td>
<td>BM</td>
<td>5712</td>
<td>Section 1.15 Business Foundations for Biomedical Innovators – 2Cr</td>
</tr>
<tr>
<td>1.08</td>
<td>BM</td>
<td>5722</td>
<td>Section 1.16 Business Foundations for Biomedical Innovators – 2Cr</td>
</tr>
<tr>
<td>1.09</td>
<td>SPN</td>
<td>7Cr</td>
<td>Section 1.17 Translation of Biomedical Solutions to Products – 4Cr</td>
</tr>
<tr>
<td>1.10</td>
<td>BM</td>
<td>5713</td>
<td>Section 1.18 Realization of Biomedical Products in the Marketplace – 1Cr</td>
</tr>
<tr>
<td>1.11</td>
<td>BM</td>
<td>5723</td>
<td>Section 1.19 Entrepreneurship for Biomedical Innovators – 2Cr</td>
</tr>
</tbody>
</table>

BME 5732
Section 1.22  **Electives** – 6 CR
Section 1.23  **Targeted Electives** (6CR must be approved by the Director of Master's studies.

**OTHER POLICIES**

**Secretarial Service**
Department secretaries do not generally provide clerical services to graduate students except in connection with scheduled courses and sponsored research projects.

**Copying Service**
Graduate students may not charge copying work to the department or a research project without prior authorization. Personal copies can be charged to a student’s personal account. The cost of copying dissertations beyond the three copies required by the department is considered a personal obligation.

This is a compilation of policies and regulations applicable to graduate students in the Department of Biomedical Engineering. Students should also become familiar with the general regulations of the Henry Edwin Sever Graduate School of Engineering and Applied Science as described in the School’s Web site: [www.engineering.wustl.edu](http://www.engineering.wustl.edu)
CONTACTS

Department of Biomedical Engineering
Washington University
Whitaker Hall, Room 190
One Brookings Drive, Campus Box 1097
St. Louis, MO 63130-4899

**Director of Master's Studies**
Dennis Barbour
Whitaker Hall 200E
314-935-7548
E-Mail: dbarbour@wustl.edu

**Master's Student Coordinator**
Jamie Skubal
Whitaker Hall 190
314-935-7208
E-Mail: jamieskubal@wustl.edu

**Websites**

https://bme.wustl.edu/graduate/Pages/degree-programs.aspx

https://engineering.wustl.edu/current-students/student-services/Pages/graduate-catalog.aspx#MastersDegree

https://engineering.wustl.edu/current-students/student-services/Pages/Academic-Calendar.aspx

http://engineering.wustl.edu/current-students/student-services/Pages/academic-integrity-policy.aspx