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# Master of Science in Biomedical Engineering Handbook



UNIVERSITY OF  
ARKANSAS

COLLEGE OF  
ENGINEERING

Department of Biomedical Engineering  
University of Arkansas  
120 John A. White, Jr. Engineering Hall  
Fayetteville, AR 72701

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## M.S. BIOMEDICAL ENGINEERING

The M.S. Biomedical Engineering program is designed to prepare graduates for careers in biomedical engineering in industry, government agencies, engineering firms or consulting firms and to provide a foundation for continued study at the post-master's level. Both thesis and non-thesis options are available for the M.S. Biomedical Engineering degree

### 1. Admission Requirements

Admission to the M.S.B.M.E. is a two-step process. First, the prospective student must be admitted to graduate standing by the University of Arkansas Graduate School (see "The Graduate School: Objectives, Regulations, Degrees" in this catalog or visit [grad.uark.edu](http://grad.uark.edu) for details). Second, the student must be admitted to the Department of Biomedical Engineering on the basis of academic transcripts, standardized test scores, three letters of recommendation and a statement of purpose.

Students with a non-engineering degree or a non-ABET-accredited engineering degree must demonstrate completion of the Minimum Admission Criteria for non-Engineering Majors prior to being admitted. Complete details for admission may be obtained in the applicable program section from the [Biomedical Engineering website](#) as well as in the BMEG graduate catalog page. A general summary of admission requirements is given below:

#### Summary of requirements for admission to the M.S. Biomedical Engineering program:

1. A B.S. or M.S. degree in engineering or engineering equivalent or completion of the Basic Engineering Education Requirements (see below) with a GPA of at least 3.0.
2. A GPA of 3.0 or higher on the last 60 hours of the baccalaureate degree.
3. A GRE score of 302 or above (verbal and quantitative).
4. A TOEFL score of at least 213 (computer-based) or 80 (internet based). This requirement is waived for applicants whose native language is English or who earn a bachelor's or master's degree from a U.S. institution.
5. Three letters of recommendation (submitted through the Graduate School Admissions Portal)
6. Statement of Purpose (submitted through the Graduate School Admissions Portal)
7. A member of the core or affiliated BMEG faculty who is eligible (graduate status of group III or higher) must agree to serve as the Major Advisor to the prospective student.

#### 1.1 Minimum Admission Criteria for non-Engineering Majors:

Prior to gaining admission into the M.S.B.M.E. program, students with a non-engineering degree or a non-ABET-accredited engineering degree must demonstrate completion of the following coursework with a GPA of at least 3.0: 3 courses in Mathematics (selected from Calculus I, Calculus II, Calculus III, Linear Algebra, and/or Differential Equations), 2 courses of university-level Biology, 2 courses of university-level Chemistry, and 2 courses of university-level (calculus-based) Physics. In addition, students will be required to enroll and complete one of the following courses to provide adequate background in Engineering Design ([BMEG 2904](#) Biomedical Instrumentation, [BMEG 3634](#) Biomaterials, [BMEG 3124](#) Biomedical Signals and Systems, or [BMEG 3824](#) Biomolecular Engineering). Students should consult the Graduate Coordinator for a complete list of courses that satisfy the Minimum Admission Criteria.

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## **1.2 Selection of Major Advisor**

The Major Advisor must be either a core or affiliated faculty member in the Department of Biomedical Engineering. The name of the Major Advisor is provided to the Graduate School at the same time that admission to the department's graduate program is granted. Therefore, it is suggested that prior to applying, all prospective students contact faculty members with whom they share mutual research interests. It is essential that the prospective student and Major Advisor have open honest discussions concerning the expectations of each relative to the other before final selection is made.

Circumstances may arise in which the Major Advisor has not been selected prior to admission to the department's graduate program. In such cases, the Department Head or the Graduate Coordinator will serve as the student's research advisor until a permanent advisor is selected. This should occur no later than the end of the first semester of graduate study and, in most situations, it is expected that the selection process will be made early in the first semester.

The selection of a research advisor is mutual; that is, the professor also chooses the students with whom he or she wishes to work. In addition, the interest of the Major Advisor is, by necessity, often driven by research contracts. Thus, the research area chosen by the student is expected to fit into the overall research program of the advisor.

If a student wishes to change Major Advisors, the request should be made both orally and in writing to the department head. The department head will consult with all parties involved before establishing the conditions, if any, under which the change may be made. Similarly, the student should consult with the department head in situations where his or her Major Advisor is unable to continue to serve in that capacity.

## **1.3 Deadlines**

The application deadlines for the M.S. program are April 1, September 1, and February 1 for the Fall, Spring and Summer semesters, respectively. Applications sent after the deadline will be considered on a case-by-case rolling basis.

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## 2. Degree Requirements

Both thesis and non-thesis options are available for the M.S. Biomedical Engineering degree. In general, students pursuing the thesis option are supported by research or teaching assistantships and conduct research under the guidance of a major advisor. Students pursuing the non-thesis options are typically not sponsored. For either option, all course work must be approved by the student's [Program Advisory Committee](#). The cumulative grade-point average on all graduate courses presented for the degree must be at least 3.0.

**Thesis Option:** 24 hours of graduate-level course work, including 5 hours of Biomedical Engineering Graduate Core as identified below, at least 10 additional hours of graduate-level classes in Biomedical Engineering, and 6 hours of research resulting in a written master's thesis. Candidates must pass a comprehensive final examination that will include an oral defense of the master's thesis. The examination is prepared and administered by the student's [Thesis Committee](#). All coursework must be at the 5000 level or above unless a request has been approved to use 4000-level courses for graduate credit. 3000-level courses are not allowed.

**Non-thesis Option:** 30 hours of graduate-level course work including 5 hours of Biomedical Engineering Graduate Core as identified below, at least 10 additional hours of graduate-level classes in Biomedical Engineering. Candidates must pass a comprehensive written final examination. The examination is prepared and administered by the student's [Program Advisory Committee](#). All coursework must be at the 5000 level or above unless a request has been approved to use 4000-level courses for graduate credit. 3000-level courses are not allowed.

**Healthcare Entrepreneurship Concentration:** 30 hours of graduate-level course work including 5 hours of Biomedical Engineering Graduate Core as identified below. The Healthcare Entrepreneurship Concentration requires 15 additional hours of required courses and 10 additional hours of graduate-level classes in Biomedical Engineering. Candidates must pass a comprehensive written final examination. The examination is prepared and administered by the student's [Program Advisory Committee](#). All coursework must be at the 5000 level or above unless a request has been approved to use 4000-level courses for graduate credit. 3000-level courses are not allowed.

### 2.1 Curriculum

#### 2.1.1 Biomedical Engineering Graduate Core (5 hours)

- BMEG 5103 Design and Analysis of Experiments in Biomedical Research
- BMEG 5801 Graduate Seminar I
- BMEG 5811 Graduate Seminar II

**NOTE:** BMEG graduate students must be enrolled in Graduate Seminar every semester. If the student has completed the 5801/5811 sequence, then they are required to enroll in 5800 and 5810 until graduation. If the student needs 1 hour to complete their 30 hour requirement, they may enroll in the 5801/5811 class one additional time.

##### 2.1.1.1 M.S. in Biomedical Engineering (Healthcare Entrepreneurship Concentration)

Business and Management Fundamentals:

- MGMT 5213 Business Foundations for Entrepreneurs

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New Venture Development (The following courses to be taken in one continuous block):

- MGMT 5323 New Venture Development
- MGMT 5313 Strategic Management
- MGMT 5413 New Venture Development II

Public Health Fundamentals (Choose one from below or another relevant course with Program Advisory Committee approval):

- PBHL 5213 Evaluation of Public Health Programs
- PBHL 5533 Theories of Social and Behavioral Determinants of Health
- PBHL 5563 Public Health: Practices and Planning

### **2.1.2 Transfer of Credit**

A maximum of 6 hours of course work may be transferred from another institution towards a master's degree at the University of Arkansas. An official transcript must be on file with the Graduate School. The [Request for Transfer of Graduate Credit Form](#) must be submitted to the Graduate School.

The following are the criteria for acceptable transfer credit:

1. The course must have been regularly offered by a regionally accredited graduate school.
2. The course must have been a bona fide graduate level course, approved for graduate credit and taught by a member of the graduate faculty.
3. The student desiring to transfer graduate credit must have been enrolled as a graduate student in the graduate school at the institution offering the course.
4. The course must appear on an official transcript as graduate credit from the institution offering the course.
5. The grade on the course must be a "B" or "A". (The student's grade point average is NOT to include grades on transfer courses.)
6. The course must be recommended by the student's major advisor and be applicable to the degree requirement at the University of Arkansas.
7. The course must not have been taken by correspondence or for extension credit.
8. The course must be acceptable to the department concerned and to the Graduate Dean.
9. The student must have satisfied the 24-week state residence requirements.
10. The course must have been taken within the time limit of the student's program at the University of Arkansas.
11. Credit from foreign universities is typically not acceptable for transfer because of academic and procedural differences between U.S. regionally accredited and foreign institutions, but petition may be made to the Graduate Dean on a case by case basis.

### **2.1.3 Retroactive Graduate Credit**

Graduate students fully admitted into a degree program may request that up to twelve hours of courses taken in the final semester of their undergraduate degree count toward their graduate degree, if these courses were taken on the University of Arkansas, Fayetteville campus. These courses may not have been used for the undergraduate degree, must be approved by the student's advisory committee, and must be at the 5000 level or above. The [Request for Retroactive Graduate Credit Form](#) must be submitted to the Graduate School.

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Note: If a student receives financial aid in their final semester in the baccalaureate program, no courses used to fulfill the minimum enrollment requirement for financial aid will be retroactively changed to graduate credit.

#### **2.1.4 Course Repetition**

Graduate students who attended the University of Arkansas, Fayetteville for their bachelor's degree should not enroll in the graduate version of any course they completed as an undergraduate. If a student previously completed one of the required BMEG graduate core courses as an undergraduate, they will be allowed to replace that core course with a graduate level course selected in discussion with the student's [Program Advisory Committee](#).

#### **2.1.5 3000-Level Courses**

Courses numbered at the 3000-level may be taken by graduate students for graduate credit only when the courses are not in the student's major area of study and when the courses have been approved by the Dean of the Graduate School for graduate credit in the student's program before the Official Enrollment Report (commonly the eleventh class day). The instructor of the proposed course must hold graduate faculty status. No more than 20 percent of the graded course work in the degree program may be comprised of 3000-level courses carrying graduate credit. The [Request for Graduate Credit for 3000 or 4000 Level Courses Form](#) must be processed by the Graduate School *before the course begins*.

At least 50% of the credits (whether coursework or research) presented for the degree must be at the 5000 level or above.

#### **2.1.6 4000-Level Courses**

Because 4000-level courses can carry dual level credit, a 4000-level course which has specifically been created to carry ONLY undergraduate credit must be individually petitioned to carry graduate credit. The [Request for Graduate Credit for 3000 or 4000 Level Courses Form](#) must be processed by the Graduate School *before the course begins*.

At least 50% of the credits (whether coursework or research) presented for the degree must be at the 5000 level or above.

### **2.2 Master's Program Advisory Committee**

The Master's Program Advisory Committee is comprised of at least three members of the graduate faculty including the Major Advisor who serves as Chair. At least one member must be selected from the core Biomedical Engineering faculty and at least two members must be selected from the Biomedical Engineering program faculty which includes non-departmental affiliated faculty. All members of the committee must be members of the Graduate Faculty of the University of Arkansas. The Major Advisor, in consultation with the student, selects the Advisory Committee, subject to review and approval by the Engineering Academic Programs Committee and the Dean of the Graduate School.

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The Program Advisory Committee should be assembled within one year of entering the program. Once the Advisory Committee has been selected, the [Master's Program Advisory Committee Form](#) must be submitted to the Graduate School.

The Advisory Committee oversees the student's program of study. All decisions of the Advisory Committee are made by majority vote. In the situation when there is a split decision among Advisory committee members, the situation must be resolved to the satisfaction of each committee member. In the event that each committee member is not satisfied, the committee member may insist on the necessary steps to reach a resolution or elect to step down from the committee. In unusual circumstances, the Dean of the Graduate School may remove a faculty member from a student's advisory committee, or make an alternative arrangement (e.g. assign a representative from the Graduate Faculty to serve on the committee).

The Advisory Committee must be kept at its full complement throughout the graduate career of the individual student. In the event of a vacancy on the Advisory Committee (occasioned by resignation, faculty leave, or inability to serve), an appropriate replacement must be made prior to the making of any committee decision. In the case of resignation, the Committee member must formally resign in a letter to the Graduate School. The Major Advisor must write a letter to add a new member, and the form specifying membership in the Advisory Committee must be resubmitted.

All decisions of the Advisory Committee are made by majority vote. The Major Advisor is responsible for transmitting Advisory Committee decisions to the Engineering Academic Programs Committee and the Dean of the Graduate School.

### **2.3 Master's Thesis Title (thesis option only)**

The [Master's Thesis Title Form](#), consisting of the title of the thesis and approved by the thesis director, should be submitted to the Graduate School as soon as the thesis topic has been established but **no later than three months prior to the date of the comprehensive examination**.

### **2.4 Master's Thesis Committee (thesis option only)**

The Master's Thesis Committee, or Thesis Committee, is responsible for insuring that the thesis presented meets high academic standards and constitutes a significant contribution to the knowledge of the study area. The Thesis Committee supervises the preparation, submission and defense of the dissertation.

In most instances, the student's Advisory Committee and Thesis Committee will have the same composition. Like the Advisory Committee, the Thesis Committee is comprised of at least three members of the graduate faculty including the Major Advisor who serves as Chair. At least one member must be selected from the core Biomedical Engineering faculty and at least two members must be selected from the Biomedical Engineering program faculty which includes non-departmental affiliated faculty. All members of the committee must be members of the Graduate Faculty of the University of Arkansas and must possess full Graduate Faculty status. The Major Advisor, in consultation with the student, selects the Thesis Committee, subject to review and approval by the



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Engineering Academic Programs Committee and the Dean of the Graduate School. Once the Thesis Committee has been selected, the [Master's Thesis Committee Form](#) must be submitted to the Graduate School **at least three months prior to the date of the comprehensive examination.**

All decisions of the Thesis Committee are made by majority vote. In the situation when there is a split decision among Thesis committee members, the situation must be resolved to the satisfaction of each committee member. In the event that each committee member is not satisfied, the committee member may insist on the necessary steps to reach a resolution or elect to step down from the committee. In unusual circumstances, the Dean of the Graduate School may remove a faculty member from a student's thesis/dissertation committee, or make an alternative arrangement (e.g. assign a representative from the Graduate faculty to serve on the committee).

The Major Advisor is responsible for transmitting Thesis Committee decisions to the Engineering Academic Programs Committee and the Dean of the Graduate School.

## 2.5 Annual Progress Reports

Each student in the BMEG graduate program is required to submit a completed [MS BMEG Progress Report](#) to the graduate coordinator by May 15<sup>th</sup> of each year. The Progress Report includes a brief summary of the student's academic and research progress in the previous year as well as a brief discussion of plans for the upcoming year. The report must be presented in-person to the Advisory Committee (either via individual or group meetings) for full approval. The purpose of the Annual Progress Report is to keep the Advisory Committee informed of progress so that it can function in its intended capacity. It also provides an opportunity for the student and the Major Advisor to gauge progress and adjust the program if necessary.

In addition to the BMEG Graduate Student Progress Report, the student and the Major Advisor are required to submit the [Annual Graduate Student Academic Review Form](#) to the graduate coordinator by May 15<sup>th</sup> of each year.

## 2.6 Master's Thesis (thesis option only)

The Master's Thesis is the culmination of the student's study and research in a M.S. degree program. This work should represent a significant contribution to the knowledge of the study area. It is expected that the Master's Thesis be of sufficient quality to allow for at least 1 first author publication by the student in peer-reviewed, mid-tier journals indexed on PubMed. This guideline is not intended to represent a required minimum or maximum number of publications required for graduation. Evaluation of whether the student's scientific contributions satisfy the MS degree requirements will ultimately be made by the Thesis Committee.

The subject should be current and pertinent to the discipline; the language should be clear and free from jargon; the grammar should be perfect; and the style, format, and quality of paper **MUST** meet requirements stated in the [Guide for Preparing Theses and Dissertations](#). The Thesis must be distributed to the Thesis committee at least **one week** prior to the oral defense. It is expected that the Master's Thesis be of sufficient quality to allow for publication in a peer-reviewed journal.

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## 2.7 Comprehensive Examination

All students in the M.S. Biomedical Engineering programs must pass a comprehensive examination. The exam should be scheduled **at least two weeks before the final submission deadline** to allow sufficient time for corrections to the thesis (Thesis option) or grading (Non-thesis option). Consult the Graduate School website for [submission deadlines](#).

For the **Thesis option**, the comprehensive examination is an oral defense of the Master's thesis. The student is expected to demonstrate technical competence in the field directly related to the thesis research as well as a broader understanding of biomedical engineering research and the scientific method. The oral defense also assesses the student's ability to respond to questions in a rational, knowledgeable manner.

The comprehensive examination for the Thesis option is administered by the Thesis Committee. All members of the Thesis Committee must participate in the final oral defense of the thesis. This participation may be by distance. If they do not participate in the final oral defense, in person or by distance, they will be asked by the Graduate School to resign from the committee.

The Thesis Committee will evaluate the student using the [M.S. Thesis Evaluation Form](#). Each committee member will fill out this form, provide comments/recommendations to the student and provide a (I) pass, (II) pass with contingency, or (III) fail decision. The student's major advisor will then collate the forms and deliver the final decision with comments/recommendations to the student. An absolute majority pass decision is required for a student to pass the examination. If any committee member indicates a pass with contingency or fail decision, the deficiencies or concerns, together with recommendations have to be explicitly stated by the committee member. The student will then have to address any deficiencies or recommendations raised by that member, to the satisfaction of each committee member. In rare instances, another defense may be required.

In the situation when there is a split decision among Thesis committee members, the situation must be resolved to the satisfaction of each committee member. In the event that each committee member is not satisfied, the committee member may insist on the necessary steps to reach a resolution or elect to step down from the committee. In unusual circumstances, the Dean of the Graduate School may remove a faculty member from a student's advisory committee, or make an alternative arrangement (e.g. assign a representative from the Graduate faculty to serve on the committee).

After passing the oral defense, the Thesis Committee will sign the [Master's Degree Record of Progress Form](#). Original signatures are required.

For the **Non-thesis option** and the **Healthcare Entrepreneurship Concentration**, the comprehensive examination is an extensive written test of knowledge comprised of topics covered by the Biomedical Engineering Graduate courses taken by the student. The comprehensive examination for the Non-thesis option is administered by the Program Advisory Committee. After passing the comprehensive examination, the Advisory Committee will sign the [Master's Degree Record of Progress Form](#).

Students may retake a failed comprehensive exam once upon the approval of the student's Thesis Committee (for Thesis option) or Advisory Committee (for Non-thesis option). A student who fails the comprehensive examination twice will be terminated from the program. Under no circumstances will a student be allowed to take the comprehensive examination more than twice.

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## 2.8 M.S. BMEG Program Requirements Checklist

Prior to obtaining the BMEG Graduate Coordinator's signature on the [Master's Degree Record of Progress Form](#), students must complete the [M.S. BMEG Degree Requirements Check Form](#).

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## 3. Other Academic Requirements/Policies

### 3.1 Getting Ready to Graduate

At the beginning of the semester the student anticipates graduating, he/she should download the relevant [Graduation Checklist](#) (Spring, Summer or Fall). The Graduation Checklist contains all important deadlines that must be met prior to graduation.

### 3.2 Tax Guidelines

Students are strongly encouraged to consult the [Tax Guidelines for Graduate Students](#) to learn about tax rules of interest to graduate students.

### 3.3 Academic Dismissal and Grade Point Requirements

Students may be dropped from further study in the Graduate School if at any time their performance is considered unsatisfactory as determined by either the program faculty or the Dean of the Graduate School. Academic dishonesty and failure to maintain a specified cumulative grade point average are considered to be unsatisfactory performance.

The College of Engineering degree requirements state that all students must earn a minimum cumulative grade point average of 3.0 on all graduate courses attempted.

### 3.4 Time Limit

All requirements for a master's degree must be completed within six consecutive calendar years from the first semester of enrollment in that program.

### 3.5 Limits on Number of Appointments to a Graduate Assistantship

Students pursuing a master's degree may receive financial support as a graduate assistant for no more than four semesters, excluding summer appointments. Subsequent appointment beyond four semesters requires approval from the Dean of the Graduate School.

***Students should consult the [UA Graduate Student Handbook](#) for complete information regarding academic requirements and policies.***

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## 4. Master's Student Forms

### 4.1 Required Degree Forms

[Master's Program Advisory Committee Form](#) – Submitted to the Graduate School as soon as the committee has been assembled and within one year of entering the program.

[M.S. BMEG Progress Report](#) – Submitted to the BMEG Graduate Coordinator by May 15<sup>th</sup> of each year.

[Annual Graduate Student Academic Review Form](#) – Submitted to the Graduate School by May 15<sup>th</sup> of each year.

[Master's Committee Form](#) – Submitted to the Graduate School for both Thesis and Program

[Master's Thesis Title Form](#) – (Thesis option only) Submitted to the Graduate School when the title of the thesis has been established and at least three months prior to the date of the comprehensive examination

[M.S. BMEG Degree Requirements Check Form](#) – Submitted to the BMEG Graduate Coordinator after all Coursework and Thesis hours have been completed.

[Master's Degree Record of Progress Form](#) – Completed after the comprehensive examination. A completed form with original signatures is submitted to the Graduate School

[Intellectual Property Disclosure Form](#) – (Thesis option only) This form must be submitted to the Graduate School with the final copies of the thesis submitted for deposit in the University Libraries

[Thesis/Dissertation Submission Form](#) - (Thesis option only) This form must be submitted to the Graduate School with the final copies of the thesis submitted for deposit in the University Libraries

### 4.2 Other Forms

[Request for Transfer of Graduate Credit Form](#)

[Request for Retroactive Graduate Credit Form](#)

[Request for Graduate Credit for 3000 or 4000 Level Courses Form](#)