

BME Doctoral Program Requirement: Semester Version

Approved by faculty Autumn 2011; updated Spring 2012; SP2015

Core Courses - Required of all PhD students

		Credits
Scientific Methods in BME	BME 6000	1
BME Seminar (4 semesters)	BME 8810-8813	2
Graduate Research Design	ChBE 5779 or Statistics 6410	3 or 4
Graduate Research Ethics	BME 6983	2
Graduate Physiology (required if student has not previously taken a physiology course)	PhysioCB 6101 or 6102	3 or
OR		
Graduate Anatomy (if student has taken at least 1qtr/sem physiology course)	ANAT 6220	5

Total 11-14 credit hours

BME Graduate Course Requirement

1. Students are required to take 4 **fundamental BME graduate courses** (12 semester credit hours) from the following list or subject to BMEGSC approval, *students must take at least 2 OSU BME fundamental courses and may take up to 2 non-BME, BME-type OSU courses, and no more than 1 non-OSU BME course, by petition.* Students must work with their academic/research advisor to determine the best courses that will prepare them for their PhD research. More importantly, *the PhD research advisor must approve courses used to satisfy this requirement. If the PhD research advisor does not approve, he/she will not sign the student's program of study and the student will not be allowed to sit for the candidacy exam.*

BioImaging: BME 5110 Biomedical Microscopic Imaging
BME 5120 Biomedical Optics
BME 5177 Biomedical AFM
BME 5186 Biomedical Ultrasound
BME 6113 Magnetic Res Spectro & Imaging I

BioMaterials: BME 5310 Advanced Biomaterials
BME 5353 Hard-Tissue Biomaterials

BioMechanics
& BioTransport: BME 5210 Advanced Biological Transport
BME 5421 Tissue Mechanics
BME 5430 Finite Element Applications in BME
BME 5470 Cellular Mechanics
BME 5475 Biofluid Dynamics of Phys Systems

M,C, & T Eng: BME 5510 Advanced Tissue Engineering
BME 5520 Cell Engineering
BME 5420 Mechanobiology
BME 5580 Excitable Cell Engineering

Micro / Nano: BME 5610 Biomedical Microdevices
BME 5635 Cellular Nanotechnology
BME 5661 Biomedical Nanotechnology I
BME 5662 Advanced Biomed Nanotechnology II
BME 5663 Intro to Microfluidics and Nanofluidics
BME 5667 BioMEMS Microfabrication
BME 5668 Biomedical Microtransducers

Devices: BME 5639 Medical Device Design
BME 5771 Biomedical Instrumentation

Other BME courses: BME 5001 Cardiovascular Bioengineering
BME 7114 Magnetic Res Spectro & Imaging II

2. Students must take at least two additional “**graduate elective**” courses (6 semester credit hours) from Appendix A. Note that any course used to satisfy requirement #1 cannot be used to satisfy the “graduate elective” course requirement. All graduate electives must be letter graded. In addition, *all graduate electives must be approved by the student’s PhD research advisor as indicated by the PhD advisor’s signature on the student’s program of study.*
3. Students must take at least two “**free elective**” courses (6 semester credits) to meet the 35 semester credit hour total. Free electives can be in Engineering Sciences, Life Sciences or Business/Technology Commercialization. No more than 1 free elective can be S/U graded. *All free electives must be approved by the student’s PhD research advisor as indicated by the PhD advisor’s signature on the student’s program of study.*
4. Elective Restrictions:
 - a. 3 of the 12 credits used to satisfy requirements #2 and #3 (i.e. graduate and free electives) must be an **advanced math course** (Math 5000 or above). Students may petition the Graduate Studies Committee to have a non-Math course satisfy this requirement.
 - b. 3 of the 12 credits used to satisfy requirements #2 and #3 (i.e. graduate and free electives) must be in the Engineering Sciences. Courses that **do not** count towards this Engineering Science requirement are noted by asterisks (*) in Appendix A. In addition, all courses listed in the Life Science section do not count towards Engineering Sciences. If the course is not listed in Appendix A, the student must petition the Graduate Studies Committee to consider the course as Engineering Sciences.

Total 24 cr hrs

Total Program Requirements

Total course requirement: **35 semester credit course hours**

Research hour requirement: **≥45 semester research hours of BME 8999**

Important: The number of research credits (BME 8999) that can be taken after Candidacy is usually limited to 3 credit-hours each semester. You will want to plan ahead and maximize the number of BME research credits taken before Candidacy, so that you are not forced to take extra courses and time to fulfill your total program credit requirements. Also, all research credits should be in BME unless primary research advisor's appointment is in another engineering department. If the latter is true then at least ½ of the research credits must be in BME.

Program & Candidacy Committee Approval

A GSC-reviewed Program of Study and Candidacy Committee must be on file with the Graduate Studies Office before the end of Spring semester (or the student's second semester of enrollment). Composition requirements of the Candidacy Committee are defined below.

Examinations

Qualifying conditions

The purpose of these qualifying conditions is to determine if a student's academic record is strong enough to indicate a good chance of success towards a doctoral degree.

Prior to taking the Candidacy Examination a student must:

1. Satisfactorily complete their approved program of study. The GSC will consider requests for students to take the exam prior to completing their entire course of study in unusual circumstances.
2. Attain a GPA of ≥3.35 in the four courses used to satisfy the BME fundamental graduate course requirements (requirement #1).
 - a. Students achieving an average GPA between 3.00 and 3.35 on the four BME fundamental courses may petition the GSC for permission to take a 5th required BME fundamental course – selected with the help of their advisor – and have their average recomputed after dropping the lowest grade.
 - b. Students achieving less than a 3.00 in the four required BME fundamental courses (or less than 3.35 after the recomputation above) will be allowed to continue towards an M.S. degree but will not be allowed to sit for their candidacy examination.
3. The student will prepare a research proposal in their chosen domain(s) which will include a clearly stated goal (either an original (i.e., distinct from the advisor's current research) Hypothesis or Technology Development objective), Specific Aims, a review and

analysis of the relevant literature, a series of proposed experiments, and a discussion of the data to be collected and the means by which it will be analyzed. Adherence to a standard grant format (e.g., NIH R-21 or NSF format) as selected by the Candidacy Examination committee is suggested. The candidate will provide the proposal to his/her research advisor at least 3 weeks prior to the beginning of the oral portion of the candidacy exam. The advisor is responsible for distributing the proposal to the Candidacy Examination committee, who will evaluate the quality of the proposal and determine if the student has satisfactorily completed this condition.

Candidacy Examination

Purpose: The Candidacy Examination is to assess the student's knowledge base and thinking ability to make a determination of their suitability to continue towards a doctoral degree. A unanimous vote of the committee members is required for the student to pass the exam. If unsuccessful, the student may petition the committee to retake the exam; unanimous approval of this request is required.

Committee Composition: Candidacy Examination committee will consist of at least 4 faculty members, two of whom have P status in BME (including at least one departmental core faculty member).

Written portion: The written portion of the exam will consist of one question from each of the candidacy committee members. These questions will be provided to the candidate one-week after distribution of the research proposal. Each candidacy examination committee member will provide one question that may be directly based on the research proposal (i.e. typical review type question) or may be based on the research area described by the candidate. Questions may also be based on course-work and/or ask for a critical review of the literature in a certain area. The candidate's research advisor is responsible for overseeing and coordinating the exam. The candidate is required to provide written responses at least one-week prior to scheduling of the oral examination and must submit written responses to both the committee member and the advisor.

An Application for Candidacy form must be complete for submission to the Graduate School via gradforms.osu.edu at least two full weeks before the date of the oral examination. All policies and reminders governing Candidacy and Post-Candidacy residency requirements at the Graduate School

website: <http://www.gradsch.osu.edu/section-vii.html>.)

Oral portion: The student will give a brief (≤ 10 minute), formal presentation of their pre-candidacy, qualifying research proposal following which the committee will examine the student on the

proposal and his/her understanding of the engineering and life science disciplines underlying the proposed research.

Students should be prepared for oral questions that examine (but are not limited to):

- * general knowledge and reasoning skills in the area of biomedical engineering (especially in the domains of their coursework and in the area of their undergraduate background), and topics raised in the written portion of the Candidacy Exam
- * the fitness of the student to formulate and address a research problem including knowledge of background materials, current literature, experimental design, methods, alternative techniques, statistical analysis, likely outcomes, etc.

Dissertation Defense

Dissertation Committee Composition: Dissertation Committee will consist of at least 3 faculty members, including at least one departmental core faculty member.

Prior to their dissertation defense, each student must schedule a presentation in BME 8813. BME 8813 Seminars are scheduled at least 1-2 semesters in advance; therefore, students must plan ahead and request to present early. It is the student's responsibility to get this scheduled; special seminars will not be added to accommodate students who fail to meet this requirement.

The student's committee will examine the student on the research project and dissertation as dictated by Graduate School procedures. An Application for Final Oral Exam must be complete for submission to the Graduate School via gradforms.osu.edu at least two full weeks before the date of the oral examination. This form must be accompanied by a draft of the dissertation document for review by the dissertation committee and for Graduate School formatting review. The presentation component of the Defense may be open to the public though the examination itself is private. The student's Dissertation committee will examine the student on the research project and dissertation as dictated by Graduate School policies. Policies governing final oral examinations and graduation deadlines and procedures can be found at the Graduate School website: <http://www.gradsch.osu.edu/section-vii.html>.

Minimum Graduation Requirements

- Completion of ≥ 35 course hours as described above with a minimum GPA of 3.00
- Completion of ≥ 45 hours of dissertation research (must be **BME 8999**)
- Successful completion of the Candidacy Examination and Dissertation Defense
- Presentation of dissertation research in a scheduled BME 8813 seminar

- Submission of two (2) manuscripts for publication in recognized scientific journals (e.g. indexed by ISI). The student should be the first author on at least one of these manuscripts
- Presentation of at least one (1) oral or poster presentation at a regional, national, or international meeting

Administration

- Students & advisors may jointly petition GSC for waivers of any of the above requirements.
- These petitions will be considered at convened GSC meetings which will occur at least every other month. *Last minute petitions may not be reviewed.*
- Changes to an approved Program or Committee must be reviewed by the GSC at least **one full semester** before an Application to Graduate is filed.
- Applications to Graduate will not be approved unless the student's final GSC-approved Program and Committees are on file in the Graduate Office and most other graduation requirements are met. Exam and Graduation procedures can be reviewed at <http://www.gradsch.osu.edu/7.13-graduation-requirements.html>. All forms should be submitted via gradforms.osu.edu at least **one full week** in advance of the Graduate School deadline. No forms will be signed by the Chair of the Graduate Studies Committee until a graduation audit has been completed.

BME Doctoral program – sample program

YEAR	FALL	SPRING	MAY / SUMMER
1	Intro to BME 1____ Research Ethics 2____ BME Seminar 0____ Physiology/Anatomy..... 3-5____ Research Design..... 3____ Research..... 3____ TOTAL = 12-14	BME Fundamental #1.....3____ BME Fundamental #2.....3____ Grad Elective #13____ BME Seminar 1____ Research3____ TOTAL =13	Research 8____ TOTAL = 8
2	BME Fundamental #3..... 3____ Grad Elective #2..... 3____ Free Elective #1 3____ BME Seminar 0____ Research..... 3____ TOTAL = 12	BME Fundamental #4.....3____ Free Elective #2.....3____ BME Seminar 1____ Research6____ TOTAL =13	CANDIDACY Research 7____ TOTAL = 7
3	Research..... 3____ TOTAL = 3	Research3____ TOTAL = 3	Research 3____ TOTAL = 3
4	Research..... 3____ TOTAL = 3	Research3____ TOTAL = 3	

Candidacy Examination will be taken at the completion of all the courses in the student's program of study. In this sample curriculum, that would be at the end of Year 2.

Total Hours = 80 [35 course hours; 45 research hours]