



IUPUI

DEPARTMENT OF BIOMEDICAL ENGINEERING

GRADUATE HANDBOOK

Master of Science Degree in Biomedical Engineering

(MS BME)

Fall, 2023

Amendments

1. First version was approved by the BME faculty on November 5th, 2010
2. Amended by the BME faculty on October 3rd, 2011
 - a. Guidelines for selection of approvable electives, page 8
 - b. Expectations for regular attendance of BME Department seminars, page 9. BME graduate students are expected to attend the BME Department seminar series.
3. Amended by the BME faculty on May 4th, 2012
 - a. Capstone requirements for Non-Thesis Master of Science students, page 8, added
4. Amended by the BME faculty on November 3rd, 2014
 - a. Guidelines of selection of elective courses for Plan of Study, pages 8-9
5. Amended by the BME faculty on May 7th, 2015
 - a. Course requirements for Thesis Master of Science students, page 8. The Thesis option minimum credit hours requirement for BME Graduate courses was reduced from 12 credit hours to at least 6 credit hours. If less than 12 credit hours are used the balance of the 12 credit hours must be from graduate level engineering courses.
 - b. Increase in the minimum TOEFL score requirements for admission. Increase the iBT Writing, Speaking, Listening, and Reading requirements as follows: W:18 → 20, S:18 →20, L:14→20, R:19→20, for a total of 79→80. The requested changes are based on the analysis of the iBT TOEFL scores of current and past students found to be lacking in sufficient English skills, and to be consistent with the Paper Test percentile score of 550.
 - c. Credit, grade and index requirements for graduation, page 7. The Primary course minimum grade requirement was increased. Students will be expected to maintain a B- or better in each course listed as “Primary” on their Plan of Study. If students receive a course less than “B-” in a course listed as Primary, they are required to retake the course.
6. Amended by the BME faculty on August 17, 2016
 - a. Guidelines for BME69700 included.
 - b. Guidelines for BME 69600 included.
7. Amended by the BME faculty on September 11, 2017
 - a. Revised procedure for course petition submission.
 - b. Updated text on English requirement for international students.
 - c. Removed BME 501/502 course requirement, and replaced with advising consultation.
 - d. Added clarification on whether BME 696 and/or 697 can be counted as Primary courses.
 - e. BME 50000 BME Grad Seminar requirement, a zero-credit hour graduate course
8. Amended by the BME faculty on August 21, 2019
 - a. Added courses to the approved list of “Mathematics, Statistics, or Life Science elective courses” in Section 11.
 - b. Clarified that transfer courses cannot be used as Primary.
9. Amended by the BME faculty on May 1, 2020
 - a. Added text to specify Graduate Advisory Committee members.
 - b. Revised Section 9 PLAN OF STUDY to reflect new procedure to file Plan of Study online.
 - c. Clarified math requirement for 5-Year BS/MS students regarding STAT 511 and 519.
 - d. Section 11 COURSE REQUIREMENT: specify that internship or work experiences may be used for graduate elective credit hours for BME 69600.
 - e. Section 12 ACADEMIC STANDING: clarify the reasons for a student to lose Good Academic Standing and the consequences.
 - f. Section 15 PREPARING THESIS AND FINAL EXAMINATION: updated the process
 - g. Added Appendix C. Sample Plans of Study (GS-6): Non-Thesis and Thesis
10. Amended by the BME faculty on December 7, 2020
 - a. Non-Thesis students: Director of the Graduate Program will serve as Faculty Advisor. No Advisory Committee needed.
 - b. BME 696 or 697 no longer required, just recommended for Non-Thesis Master’s students.
 - c. Added note about Engineering electives: most, but not all are automatically approved.

11. Amended by the BME faculty on August 16, 2021
 - a. Added BIOL 564 to the approved list of “Mathematics, Statistics, or Life Science elective courses” in Section 11
 - b. Combined information on “Transfer Credits” in Section 11.
12. Amended by the BME faculty on August 17, 2022
 - a. Added text on Section 9 Course Requirements to better define Primary and Related (Elective) courses for Thesis and Non-Thesis students
 - b. Added text on Section 9 Course Requirements to address the BME seminar requirement
 - c. Reorganized Section 9 Course Requirements for better information flow
 - d. Clarified text under Section 10 and Section 11 to better organize the information to highlight the requirements that must be met for graduation

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1. INTRODUCTION

This handbook addresses common questions from applicants and current graduate students concerning the Master's program of study in Biomedical Engineering at IUPUI. Information is provided concerning the application process, establishing a program of study, required scholastic performance and general administrative expectations of the IUPUI Graduate School and the Department of Biomedical Engineering.

2. BIOMEDICAL ENGINEERING FACULTY

As of Fall 2022, the core biomedical engineering faculty at IUPUI are:

Karen Alfrey, Ph.D.	Rice University, 2000. Computational biology, neuronal modeling; biological control systems
Edward Berbari, Ph.D.	University of Iowa, 1980. Computer-based medical instrumentation, biomedical signal processing, cardiac electrophysiology and biophysical modeling
Jennifer Hatch, M.S.	Indiana University Purdue University Indianapolis, 2021
Steven Higbee, Ph.D.	Rice University, 2013. Biomaterials and tissue engineering, undergraduate research
Julie Ji, Ph.D.	University of Pennsylvania, 2004. Endothelial mechanobiology, cell and nuclear mechanics, signal transduction in human diseases
Chien-Chi Lin, Ph.D.	Clemson University, 2007. Development of functional hydrogels for tissue regeneration and controlled release applications
Sharon Miller, Ph.D.	University of Michigan, 2008. Biomaterials and tissue engineering
Sungsoo Na, Ph.D.	Texas A&M University, 2006. Cellular/molecular mechanics and mechanotransduction of skeletal and vascular systems
John Schild, Ph.D.	Rice University, 1995. Electrophysiological and computational study of neurocirculatory control
Rachel Surowiec, Ph.D.	University of Michigan, 2019. Biomedical imaging, quantitative MRI
Joseph Wallace, Ph.D.	University of Michigan, 2007. Biological and environmental factors influencing the organization and assembly of bone
Dong Xie, Ph.D.	Ohio State University, 1998. Polymer biomaterials
Hiroki Yokota, Ph.D.	University of Tokyo, 1983. Indiana University, 1993. Biomechanics and systems biology of bone and cartilage
Ken Yoshida, Ph.D.	University of Utah, 1994. Neural engineering, bioinstrumentation

3. GRADUATE SCHOOL ADMISSION REQUIREMENTS

Students are required to take the Quantitative, Analytical Writing and Verbal GRE exams. Successful applicants typically have scores above the 60th percentile and a minimum undergraduate Biomedical Engineering GPA of 3.0/4.0 from an ABET accredited institution. Applicants with an undergraduate degree in Biomedical Engineering from an educational institution outside of the US are required to take the TOEFL exam. The minimum TOEFL scores required before an application will be considered are the following:

- **Internet-based test (iBT):** The following five (5) minimum scores must be met: Writing: 20, Speaking: 20, Listening: 20 and Reading: 20; and Total score: 80.
- **Paper-based test:** the minimum acceptable score is: **550**.

The British Council's International English Language Testing System (IELTS) is acceptable in lieu of the TOEFL. A minimum overall IELTS band score of 6.5 is required for admission.

4. APPLICATIONS FROM NON-BIOMEDICAL ENGINEERING MAJORS

Preliminary coursework may be required before admission into the program if, in the opinion of the Biomedical Engineering Graduate Education Committee (GEC), an applicant appears capable of graduate level work but would benefit from additional study in select academic areas. The following course listings should be used as a guide for self-assessment. The GEC most often will identify needs for additional study in these areas.

Mathematics and Physics Requirements

Graduates of an ABET accredited program other than Biomedical Engineering or graduates from a non-ABET accredited program must provide evidence of proficiency in the following academic areas (IUPUI course equivalents listed):

MATH 16500	Analytic Geometry and Calculus I
MATH 16600	Analytic Geometry and Calculus II
MATH 17100	Multidimensional Mathematics
MATH 26100	Multivariate Calculus
MATH 26600	Ordinary Differential Equations
PHYS 15200	Mechanics
PHYS 25100	Heat Electricity Optics

Engineering and Life Science Requirements

Graduates from a discipline other than Biomedical Engineering will need to demonstrate some depth of academic proficiency consistent with the anticipated area of study (e.g., bioelectricity, biomechanics, biomaterials, biofluids, etc.). At a minimum, the academic areas most often cited by the Committee include (IUPUI course equivalents listed):

BME 32200	Probability and Application in BME
BME 33100	Biosignals and Systems
BIOL K324	Cell Biology

The extent to which additional study is required to prepare the applicant for graduate level work in Biomedical Engineering is greatly dependent upon the nature of the undergraduate degree (e.g., B.S. vs. B.A., engineering vs. non-engineering, biology vs. chemistry, etc.) Those areas most often cited by the Committee include (IUPUI course equivalents listed):

BME 22200	Biomeasurements
BME 24100	Introduction to Biomechanics
BME 33400	Biomedical Computing
BME 38100	Implantable Materials
BME 35200	Cell and Tissue Behavior and Properties

Summary

Applicants with an undergraduate engineering degree in a discipline other than Biomedical Engineering who can show evidence of proficiency in these Mathematics, Physics, Engineering and Life Science requirements are given full consideration for admission by the Committee. Applicants with a non-engineering undergraduate degree must show quantitative evidence of proficiency in these areas (for example, obtaining at least a grade of "B" in any course recommended by the Committee). Demonstrated proficiency with at least one high level computer programming language or a command interpreter such as MATLAB is also required.

Once admitted, students with a non-BME undergraduate background are required to meet with their advisor at the start of the program, to discuss if additional courses are needed to prepare them for the BME program. In consultation with an advisor and other faculty in area of interest, students may be asked to take fundamental courses in BME. These classes would not count toward the credit requirements for the Master's Degree in Biomedical Engineering.

5. ENGLISH LANGUAGE REQUIREMENTS FOR INTERNATIONAL STUDENTS

A student whose first language is not English must take the English for Academic Purposes (EAP) Placement Test. You are exempt from taking the EAP exam if you scored at least: 100+ on TOEFL or 7.5+ on IELTS. Those students with noted deficiencies based on EAP scores are required to take one or more EAP courses or equivalent, for example TCM 460. Language related courses cannot count towards the credit requirements for the Master's Degree in Biomedical Engineering.

6. ADVANCE, FINAL, AND LATE REGISTRATION

Each semester a graduate student can pre-register for courses offered in the following semester during the advance registration period of the current semester. Students already in residence are strongly urged to advance register. New students may advance register if they come to campus during the semester before starting graduate work.

If advance registration is not possible, students should register during the final registration period. Final registration follows the same procedure as advance registration and is held during the week preceding the beginning of classes.

Any student who has not utilized the advance or final registration periods must schedule under late registration which begins the first day of classes and continues for one week. Penalty fees will apply and the student should consult the Bursar's Office.

Dropping/Adding Courses

Each graduate student is expected to be aware of all procedures, late fees, refund deadlines, etc. associated with dropping/adding of courses. Students may drop/add courses online during the open registration period. However, once the open registration period ends, students must use a Drop/Add form to change a course. Information on procedures and deadlines are available on the IUPUI Registrar's website.

7. FACULTY ADVISOR AND ADVISORY COMMITTEE

Graduate students in both Thesis and Non-Thesis Programs of study are expected to have a Faculty Advisor by no later than the end of the first semester of study.

For Thesis students employed as a full time Graduate Research Assistant, the Faculty Advisor is the faculty member sponsoring the Master of Science Thesis research project. The Faculty Advisor and student must establish a Graduate Advisory Committee. It is the responsibility of this committee to assist the student in finalizing a formal Plan of Study for fulfillment of the Master of Science degree requirements. This Advisory Committee conducts all necessary examinations related to the Master of Science Thesis research for Thesis students. The Graduate Advisory Committee generally consists of three members: Faculty Advisor (BME faculty), a professor knowledgeable of the major field of study, and a professor representing a related area of research. In case the Faculty Advisor for a thesis project is not a primary BME faculty, then a BME faculty must serve on the Committee as co-Chair and faculty of record.

For Non-Thesis students, the BME Director of the Graduate Program will serve as their Faculty Advisor, and Graduate Advisory Committee is not needed. The Faculty Advisor will review student's performance and conduct all course requirements for Non-Thesis students.

8. PLAN OF STUDY

In the first semester of the program, all graduate students should consult with their Faculty Advisors first to finalize courses to be put on the Plan of Study and choose members of the Advisory Committee. Students should contact members of their Advisory Committee to confirm their participation.

Filing of the *Plan of Study Form* (GS-6) is now done online via the Purdue Graduate School Portal website. Near the end of the first semester, students will receive an email from the Purdue Graduate Recorder with instructions to set up a Purdue Career Account (PCA). Once complete, students can log in and follow directions online to complete the Plan of Study and submit Advisory Committee members. All relevant signatures will be obtained electronically. The completed form is then recorded in the student's academic file. Approval by the Director of the Graduate Program and the Graduate School officially establishes both the Plan of Study and the Advisory Committee.

The BME Graduate Program Coordinator can assist with the logistics of filing a Plan of Study. The Appendix at the end of this document includes helpful hints for filing Plan of Study (GS-6) as well as sample Plans of Study for Thesis and a Non-Thesis degree programs. **Each student is expected to file the *Plan of Study Form* (GS-6) no later than 4 – 6 weeks into the second semester of graduate program.** Students failing to meet this requirement will loss Good Academic Standing, and will not be permitted to register for additional courses or thesis project credits.

Change to the Plan of Study

To make changes to an approved Plan of Study, the *Request for Change to the Plan of Study Form* (GS-13) must be electronically submitted through the PCA. This form is also used

to: request a change of Faculty Advisor, major professor or other members of the Advisory Committee, and for a change between Thesis and Non-Thesis Master of Science degree options. For more information, see Section 12.

9. COURSE REQUIREMENTS

The 30 credit hours required for graduation must be distributed according to the following rules:

Plan of Study with a Thesis option:

6 - 12	credit hours	Graduate Biomedical Engineering courses*
0 - 6	credit hours	Graduate Engineering courses*
0 - 6	credit hours	Approved graduate Life Science courses*
3	credit hours	Approved graduate Mathematics or Statistics courses
9	credit hours	Thesis research

Plan of Study with a Non-Thesis option:

12	credit hours	Graduate Biomedical Engineering courses (Primary)*
0 - 6	credit hours	Approved Graduate Life Science or Engineering elective courses
9 - 15	credit hours	Approved Graduate Engineering electives
3	credit hours	Approved Graduate Mathematics or Statistics courses

* Primary vs. Related Courses

All students in the Master of Science degree programs are required to take at least four (4) “Primary” courses for the approved Plan of Study and must maintain a grade of “B-” or better for the Primary courses. These Primary courses are supposed to be most aligned with the student’s declared area of concentration of research interest.

Non-Thesis students: all four (4) Primary courses must be Graduate Biomedical Engineering courses. The 12 credit hours of Graduate Biomedical Engineering should comprise the four required Primary (P) courses of the Plan of Study.

Thesis students: 12 credit hours of four (4) required Primary (P) courses are also required for the Plan of Study. However, to accommodate the different background knowledge and skills needed for specific research project, only two (2) of the four required Primary courses must be Graduate Biomedical Engineering courses. At minimum 6 credit hours of Graduate Biomedical Engineering courses must be included in the Plan of Study. If less than 12 credit hours of Graduate Biomedical Engineering courses are included, the balance of the 12 credit hours must be approved Graduate Life Science or Engineering courses.

Aside from the Primary courses, the rest of the Plan of Study should comprise of one graduate Mathematics or Statistics requirement and other Engineering and Life Science Elective courses, which are identified as “Related” on the Plan of Study.

BME 696/697 Option

Non-Thesis students have the option of completing 3 credit hours devoted to a single capstone project, in BME 69600 Advanced Biomedical Engineering Projects, sponsored by a faculty member. Alternatively, graduate students pursuing a course only (no project) Non-Thesis Plan of Study may take 69700 Directed Reading in BME. The offering of either BME 696 or 697 options each semester depends on faculty availability.

In some instances, a faculty sponsor may use BME 697 as an opportunity to impart to students the background needed for a BME 696 project. Those students would take BME 697 prior to 696. Only one, BME 696 or 697, can be counted as a Primary on a student's Plan of Study. If a student has taken both, BME 696 can be counted as Primary, and BME 697 will count as either an elective. Prior approval from the Faculty Advisor is required to take either course. If either BME 697 or 696 is sponsored by a faculty outside of the BME Department, a faculty of record within BME will be chosen by the Director of the Graduate Program.

BME 69600 or BME 69700 are highly recommended, but not required for all Non-Thesis Master's students. See Appendix A for detailed guidelines for BME 697 and 696.

Seminar Requirement

The BME Department sponsors many opportunities for academic, scientific research, and professional career enrichment. Graduate students are strongly encouraged to make the most of these opportunities to ensure their training is grounded in a broader understanding of the BME field and its role in advancing medical science. Consequently, all BME graduate students are required to register for four (4) semesters of the BME Graduate Seminar (BME 50000) and pass with a Satisfactory grade. This course may include attending departmental seminars, invited speaker series plus other talks, as well as Graduate Student Association sponsored meetings. This is a zero-credit hour course but a grade of Satisfactory or Unsatisfactory is assigned at the end of the semester.

Guidelines of Selection of Courses for Plan of Study

For Primary courses, research interests of the faculty as well as the course offerings of the BME department can be generally categorized into three areas of concentration:

- Biomaterials / Tissue Engineering
- Biomechanics / Mechanobiology
- Bioinstrumentation/Neural Engineering/Biosignal Processing

Engineering Elective Courses

In general, IUPUI graduate courses at the 500 level and above offered by the ECE and MEE departments are acceptable as approved engineering elective courses. However, depending on the topic and content, some may not be approved as engineering electives. Please consult with your Faculty Advisor to confirm approved ECE and ME courses.

Mathematics, Statistics, or Life Science Elective Courses

BME offers its graduate students considerable flexibility in selecting life science and discipline specific electives. There is, however, an implied expectation that course selections

will follow a unified theme in BME that is consistent with the student's research thesis, capstone project, or academic Plan of Study.

The BME Graduate Committee has reviewed and approved the following courses for inclusion on a Plan of Study for the Master of Science Degree in Biomedical Engineering. However, approval of the Faculty Advisor and Advisory Committee is needed for courses to apply toward the student's Plan of Study.

DEPARTMENT	Course #	Course Title
ANAT-D	50100	Human Gross Anatomy
ANAT-D	52700	Neuroanatomy
BIOL	56100	Immunology
BIOL	57310	Stem Cell Biology
BIOL	55600	Physiology I
BIOL	50700	Principles of Molecular Biology
BIOL	51600	Molecular Biology of Cancer
BIOL	57400	Molecular and Cell Bone Biology
BIOL	55900	Endocrinology
BIOL	56400	Molecular Genetics and Development
CHEM	53300	Intro to Biochemistry
CHEM	62100	Advanced Analytical Chemistry
GRAD-G	819	Basic Bone Biology
MATH	51000	Vector Calculus
MATH	51100	Linear Algebra with Applications
MATH	52500	Intro to Complex Analysis
MATH	53700	Applied Math Scientists/ENGR I
MATH	55200	Applied Numerical Methods II
MATH	55400	Linear Algebra
MNEU-N	612	Neurotransmitter Dynamics & Synaptic Plasticity
MNEU-N	614	Special Senses & Integrated Neurophysiology
MNEU-N	616	Developmental Biology of Neurons
PHSL-F	503	Human Physiology
STAT	51100*	Statistical Methods I*
STAT	51200	Applied Regression Analysis
STAT	51400	Design of Experiments
STAT	51600*	Basic Probability and Applications
STAT	51900*	Introduction to Probability*
STAT	52300	Categorical Data Analysis
STAT	52800	Intro to Mathematical Statistics
PBHL	B561	Introduction to Biostatistics 1

* STAT 511, 516, 519 cannot be used by 5-Year BS/MS degree students from IUPUI on their Plans of Study due to overlap with BME32200.

Course Petition

Courses on this list **do not require prior approval** and can be considered as acceptable for a Plan of Study. This assumes the selection adheres to the credit allocations for

the Thesis and Non-Thesis degree options and is thematically consistent with the Master of Science student's research thesis, capstone project, or area of interest and concentration.

Furthermore, all graduate courses at the 500 level and above offered by the School of Science and the IU Schools of Medicine, Dentistry, Nursing, etc. that are NOT on the list can be approved for the Plan of Study. Students must first review the selection(s) with their Faculty Advisor and then petition the BME Graduate Education Committee (GEC) by notifying the Chair the advisory committee via email and filling out a *Course Request Petition Form*. The student must submit a course syllabus and an outline of lecture topics (if available), along with the form, to the BME Graduate Program Coordinator. The Faculty Advisor and BME GEC will then determine if the course has a sufficient life science focus and rigor to be added to an approved Plan of Study for the Master's Degree in BME.

Transfer Credits

It is a rule for all graduate degree programs in the Purdue system that no more than 12 graduate credit hours can be transferred onto a Plan of Study from an outside institution or some other IUPUI graduate degree program. Transfer courses are not included in the computation of the cumulative grade point index. As a result, transfer courses cannot be used as Primary, but only as related electives.

Guidelines: Miscellanea

For the math course requirement there is considerable flexibility in terms of acceptable courses. For a math course to be approved, careful consideration is given to the level of analytical rigor in the course material and thematic consistency with the topic of the Master student's research thesis, project, or area of concentration.

Non-Thesis part time students who work in a BME related field or students who engage in BME related internships may receive graduate academic credit through enrollment in BME 69600 Advanced Biomedical Engineering Projects. The project and expectation for deliverables must be approved by the BME Graduate Committee. Approval must occur before the start of the semester of enrollment in BME 69600. The Director of the Graduate Program or a BME faculty member with related interests will serve as the instructor of record.

Deviations from these course requirements must be approved in advance by the BME Graduate Education Committee and the Chair of the BME Department.

10. CREDIT AND GRADE REQUIREMENTS FOR GRADUATION

In order to graduate with a Master of Science from Biomedical Engineering, it is required to have completed 30 graduate level credit hours. The following requirements regarding course credits and grade must be met for graduation.

- All students in the Master of Science degree programs are required to take at least four (4) Primary courses for the approved Plan of Study and maintain a grade of B- or better for the Primary courses.

- The Primary courses with a grade lower than B- must be retaken for fulfilling the Plan of Study requirements.
- Only grades of C- or higher are acceptable in fulfilling the academic expectations set forth in the Plan of Study, and the Advisory Committee requires a grade of "B" or better in certain courses.
- Grades of "Pass/Fail" are not acceptable for any course listed on the student's Plan of Study.
- Grades of "Incomplete" must be cleared in the semester immediately following the semester in which the grade of Incomplete was awarded. Failure to do so may result in replacement with a grade of "F" and dismissal from the program.
- Students in both the Thesis and Non-Thesis Master of Science degree programs must have a cumulative grade point average of at least 3.0 for all courses listed on the approved Plan of Study to be eligible for graduation with a Master of Science degree in Biomedical Engineering.

Minimum Grade Requirements

Without exception, the Master of Science Degree in BME will not be awarded to a graduate student with a cumulative grade point index below (cGPA) 3.00 (4.00 scale). The cumulative grade point index is calculated using the courses that are listed on the approved Plan of Study. If a course is taken more than once while the student is enrolled as a graduate student, only the most recent grade received in the course will be used in computing the cGPA. Transfer courses are not included in the computation of the cGPA. Any course on the Plan of Study that carries a grade of "D" or "F" must be repeated.

11. GOOD ACADEMIC STANDING

All graduate students begin their program of study in Good Academic Standing. In order for graduate students to remain in Good Academic Standing, they must maintain minimum standards of academic performance that are set by the Biomedical Engineering Department. These expectations are in addition to the minimum standards of performance and personal behavior set forth by the IUPUI Graduate School.

To stay in Good Academic Standing, a Master of Science graduate student must maintain a semester grade point average of at least 3.00 (4.00 scale) at the end of each semester of study. Any student with a semester GPA below 3.00 should self-report and meet and discuss with their academic advisor as soon as possible. Registration is then restricted. Students are required to meet with their Faculty Advisor before the registration hold can be lifted before registering for classes next semester.

Failure to register and pass four (4) semesters of BME 500, will result in loss of Good Academic Standing, and prevent graduation.

If a thesis student earns grades less than "Satisfactory" in thesis research credit hours, a student would be put on probationary status prompting the BME Graduate Committee to

recommend a remediation plan to the student's Advisory Committee. If a grade less than "Satisfactory" persists after remediation, the BME Graduate Committee will review the case and determine if removal from the Master's program is required.

Other reasons that could result in a student's loss of Good Academic Standing include:

- Any incidences of Academic Misconduct
- Failure to submit their Plan of Study in time (by second semester of the program)
- Failure to rectify any Incomplete grades promptly in their academic program

Students who lose Good Academic Standing for two semesters, consecutive or not, will be placed on Academic Probation. A student on Academic Probation will not be permitted to register for further graduate courses until an academic review has been carried out by the BME GEC. The outcome of this review may be either dismissal from the Master of Science degree program, or a list of expectations the student must achieve in the next semester (for example, minimum academic performance in specific graduate courses).

If these requirements are violated for a total of three semesters, the BME GEC, in consultation with the student's Advisory Committee and Major Professor, reserves the right to terminate the student from the graduate program at the end of the current semester.

12. CHANGES IN ACADEMIC PROGRAM

As a student progresses through their course work and research, there may arise conditions that make it necessary to make changes to their approved Plan of Study and/or changes to their research objectives. Such changes, when based on appropriate academic reasons, are generally acceptable, and the required form GS-13, *Request for Change to the Plan of Study*, must be completed and filed with the Graduate School. However, the following rules must be observed:

- A course **cannot** be removed from an approved Plan of Study once the course has been taken and a grade of "D" or lower has been received. This course must be repeated, and the student must receive at least of grade of "C" before the course can be removed from an approved Plan of Study. This rule is mandated by the Purdue Graduate School.
- Any change to a Plan of Study and subsequent filing of form GS-13 requires approval of the student's Graduate Research Advisory Committee, Director of the Graduate Program, and the Chair of the Biomedical Engineering Department.

13. INACTIVE ACADEMIC STATUS

Students who do not enroll in classes for three (3) consecutive academic sessions, including summer sessions, will be automatically assigned an Inactive Academic Status and are no longer considered to be in Good Academic Standing by the Biomedical Engineering Graduate Education Committee. While under an Inactive Academic Status, no progress can be made toward completion of the Master of Science degree requirements. In order to be removed from an Inactive Academic Status and returned to an Active Academic Status, the student must complete a new application with the Graduate School requesting re-admission. While all other supporting application materials (GRE, transcripts, etc.) are *not required* for re-

admission to the Graduate School, these and other materials may be required for re-admission into the Biomedical Engineering Department and return to Good Academic Standing in the Master of Science degree program. Students should consult with the BME Graduate Education Committee to clarify and confirm Committee expectations in order to return to Good Academic Standing in the Master of Science degree program.

Students must wait for their applications for re-admission to be officially approved by the Purdue University Graduate School before enrolling for classes. Registration activities that take place while under Inactive Academic Status and before a new application for re-admission has been officially approved by the Graduate School are considered invalid and will not count toward graduate credit.

14. PREPARING THESIS AND FINAL EXAMINATION

- All students preparing a Thesis document and a final oral examination *must attend* a Thesis/Defense Preparation Briefing. These sessions are regularly offered by the Office of Graduate Programs in the School of Engineering and Technology with dates, times, and locations reposted each semester. Each Master of Science student is expected to complete this briefing prior to composing the first draft of the Thesis. Generally, the student and major professor begin working through drafts of the Thesis at least 2-3 months before the anticipated date of the Final Oral Examination. Therefore, it would be prudent to complete a Thesis/Defense Preparation Briefing the semester before the anticipated date of the Final Oral Examination.
- All requirements and deadlines must be met for successful completion of Final Oral Examination and Thesis deposit for graduation.
- Students must complete and submit form GS Form-8, *Request for Appointment of Examining Committee*, to the Graduate Program Coordinator in the BME Department **at least four weeks prior** to the anticipated Final Oral Examination date. The Purdue Graduate School requires that the date, time, and location of the Final Oral Examination be registered at least three weeks in advance of the oral examination.
- Thesis students must have initiated form GS Form-7, *Report of Master's Examining Committee*, and form GS Form-9, the *Electronic Thesis Acceptance Form* before their Oral Examination, to be completed by Advisory Committee members following their oral presentation. Consult with the BME Graduate Program Coordinator.
- Thesis students must adhere to the standards set forth in the *Manual for the Preparation of Graduate Theses* published by the Purdue Graduate School and available from the department Graduate Program Coordinator.
- It is incumbent upon the student to adhere to the requirements and guidelines stated in this manual. The Purdue Graduate School will not accept a Thesis that has improper or inappropriate formatting. In such cases, the Thesis will be returned to the student for revision before the Master of Science degree can be conferred.

- Students must purchase one set of Purdue Thesis black binder and submit a bound copy to their Thesis advisor, as well as the electronic thesis deposit (ETD) to the Purdue University Graduate School per deposit instructions.
- Students must check with their research advisors to determine whether their Thesis needs to be kept confidential. If confidentiality is required for your Thesis, form GS-15, *Request for Confidentiality* must be filed with the BME Graduate Program Coordinator upon completion of the Final Oral Examination.
- The student must personally meet with the Graduate Program Coordinator for verification of Thesis document format.
- The final, approved Thesis document for the Purdue Graduate School must be deposited at the IUPUI Graduate Office by the published semester deadline. More detailed instruction will be provided to graduating students during their final semester.
- Students should **allow at least 2 days** to complete all of the final revisions for Thesis formatting and administrative paperwork related to the Thesis deposit process. While all of this takes place after successful completion of the Oral Examination, a Master of Science degree cannot be conferred until the Thesis has been officially recorded with the Purdue University Graduate School.
- **Non-Thesis students:** are required to electronically submit GS Form-8 *Request for Appointment of Examining Committee* and GS Form-7 *Report of the Examining Committee* in their Purdue Career Account.

15. FINAL EXAMINATION COMMITTEE

The Final Examination Committee consists of at least three members. One member must be the Graduate Faculty Advisor. The others are appointed by the Faculty Advisor and most often consist of the members of the Graduate Research Advisory Committee. The Final Examination Committee evaluates the Thesis and conducts the Final Oral Examination. As a hedge against unanticipated problems with the Thesis research, each member of the Committee should have a copy of the Thesis document **at least one month prior** to the final oral examination.

For those students enrolled in a project-based Non-Thesis Plan of Study, a similar but less formal committee must review oral presentation and final report of the capstone project (BME 69600 Advanced BME Projects). Those graduate students pursuing a course-only Non-Thesis Plan of Study may choose to make an oral presentation to same committee summarizing their final report from BME 69700 Directed Reading in BME.

16. SUMMARY OF THE MAJOR STEPS TOWARD OBTAINING A MASTER OF SCIENCE DEGREE IN BME

The following is an abbreviated list of the various steps which must be taken along the path toward a Master of Science Degree in Biomedical Engineering.

- A. Before registering for classes each semester, report to your Faculty Advisor. If a Faculty Advisor has yet to be established, the student should report to the Director of the Biomedical Engineering Graduate Program.
- B. Before registering for the first semester of classes, ensure what steps must be taken to fulfill any English language proficiency requirements if necessary.
- C. Before the end of the first semester, establish a Faculty Advisor and inform the Director of the Biomedical Engineering Graduate Program. As soon as is practically possible, the student and Faculty Advisor should form a Graduate Research Advisory Committee.
- D. No later than 4-6 weeks into the second semester of study, the student, working in conjunction with the Faculty Advisor and Advisory Committee, should file a Plan of Study with the Purdue University Graduate School. The *Plan of Study Form* (GS-6) is now done online via the Purdue Graduate School Portal website. Sample Plans of Study for Thesis and Non-Thesis degree programs are provided at the end of this document along with a few helpful instructions.
- E. Ideally, steps C and D should be completed BEFORE the start of the second semester. Failure to do so means the second semester consists of course work that has not been reviewed and approved by the student's Graduate Advisory Committee.
- F. If possible, all English language proficiency requirements should be completed by the end of the first semester of study. All English language proficiency requirements must be successfully completed no later than the end of the second semester of study. The Graduate School will not approve the Plan of Study nor the formal appointment of the Graduate Advisory Committee until all English language proficiency requirements have been fulfilled.
- G. Submit any request for a change of Plan of Study to the Graduate School before classes begin in the semester you plan to graduate. The Plan of Study must be in its final form and received by the Graduate School before the first day of the last semester in order to be eligible for graduation.
- H. Follow the steps outlined in Sections 15 and 16 for administrative processing of the Thesis document and preparing for the Final Oral Examination.

Appendix A. Guidelines for BME 697 and 696

Guidelines for BME 69700 Directed Reading

BME 697 is a reading course designed for students to gain background and up-to-date knowledge about a specific BME topic. The course is offered by individual faculty with expertise in the selected topic. Description of the individual sections of BME 697 will be posted through usual communication venues and students interested in the course should discuss with their Faculty Advisor prior to signing up for the course. The following guidelines are established to ensure the rigor of the course:

- The course instructor should submit a list of reading materials (research articles, review articles, book chapters, books, etc.) to the GEC no later than the first week after the semester starts.
- Course will be advertised on the BME Programs site. The announcement should include the topic of the reading course, schedule of meetings, and any expectation from the faculty instructor. Instructor permission is mandatory for students who are interested in registering for the course.
- Students should not register for more than 3 credit hours (1, 2, or 3) for the course.
- Unless approved by the Graduate Education Committee, BME 697 **cannot** be used as a Graduate Biomedical Engineering Course (Primary course) on the Plan of Study.
- At the end of the semester, students are required to submit a written report to the GEC summarizing the materials covered in the course. The level of expectation varies depending on the credit hours registered.
- **1 cr:** Submit a written report that summarizes the reading materials. The student should demonstrate **Knowledge** and **Comprehension** of the reading materials.
- **2 cr:** Submit a written report that summarizes the reading materials and a section of critical evaluation. The student should critically evaluate the reading assignments. The written report should start with a summary of the reading materials and finish with a section of critical evaluation on selected reading assignments. In addition to **Knowledge** and **Comprehension**, the student should demonstrate **Application** (the ability to apply knowledge) and **Analysis** (break down ideas into simple thoughts). Some examples of critical evaluation include commenting on the strengths and weaknesses of ideas proposed in the reading, or comparing and contrasting two or more methodologies.
- **3 cr:** Submit a written report that summarizes the reading materials. In addition to critical evaluation of the reading materials, students should also develop/identify a scientific/engineering problem within the realm of the topic. With assistance from the faculty instructor, the student should also offer potential engineering, analytical, or technical solutions to the problem. The written report should include all components described above. The student should demonstrate the **Synthesis** and **Evaluation** levels of comprehension as defined by Bloom's Taxonomy.
- The instructor of record for the BME 697 section will be a regular faculty member. In cases where the Directed Reading sponsor (main instructor) is an adjunct faculty, non-BME faculty, or external sponsor, a regular BME faculty member will serve as the instructor of record to help guide the external main instructor adhere to the aim and spirit of the course and help in the assessment and assignment of the student's course grade.

Guidelines for BME 69700 Evaluations:

- **Report language:** The summary report should be written in scientific language with appropriate citations. Students are encouraged to seek professional assistance on the structure and writing of the report.
- **Report length:** The length of the report should be appropriate to the level (i.e., credit hour) of the effort.
- **Critical evaluation:** With the assistance from the instructor, students will be trained to develop original critical evaluation.
- **Problem solving:** Students are not required to propose original ideas and solutions for the scientific/engineering problems. However, based on the reading materials, they should provide logical evolution and correlation between the scientific/engineering problem and the potential solutions.
- **Grade recommendation:** The course grade for the student will be assigned by the instructor based upon the participation of the student in the regular meetings with the instructor and the quality of the report based upon the guidelines above. Reports will be submitted to the BME Graduate Committee at the end of the semester. The Graduate Committee will scan the report for plagiarism as well as assess the quality of the report and course grade assigned by the instructor against the course expectations and above guidelines. Feedback will be given to the instructor of record to ensure consistency of scoring and quality across BME 697 sections. Feedback, in particular to adjunct faculty, external sponsors, and junior faculty (< 3 years in the department) will play an important role in establishing consistency in the scoring of BME 697 across sections.

Grades should be assessed in terms of degree of meeting expectations laid out per the number of course credit hours, above. The degree of meeting expectation, evidenced by the report, should be assessed against the following descriptors: A = Excellent, B = Very Good, C = Fair, D = Poor, F = Failure. Please note that graduate students are expected to maintain a cumulative B grade on courses on their Plan of Study to graduate from the program.

Guidelines for BME 69600 Advanced Biomedical Engineering Projects

BME 696 is a project-oriented course designed for students to gain hands-on experience in solving a specific BME problem, as well as to learn techniques in data processing, interpretation, and presentation. The course is offered by individual faculty with expertise in the selected BME topic. Description of the individual sections of BME 696 will be posted through usual communication venues, and students interested in the course should discuss with their Faculty Advisor prior to signing up for the course. If appropriate, before undertaking any BME 69600 Advanced BME Project the student should complete a comparable number of BME 69700 Directed Reading credits with the same Project Mentor. Doing so will ensure the student has sufficient knowledge of the Mentor's research area to accomplish the project objectives as well as understand the technical significance of the work. The following guidelines set expectations concerning course rigor and reporting:

- The course instructor should submit a summary of the project to the GEC **at least one week before the semester starts**.
- Instructor permission is mandatory for students who are interested in registering for the course.
- Students should not register for more than 3 credit hours (1, 2, or 3) for the course.
- Unless approved by the GEC, BME 696 **cannot** be used as a Graduate Biomedical Engineering Course (Primary course) on the Plan of Study.
- At the end of the semester, students are required to make a 15-minute presentation to the GEC summarizing the work conducted in the project and submit a written report to the GEC summarizing the progress of the project. The level of expectation varies depending on the credit hours registered. If the project involves multiple researchers (e.g., undergraduate and graduate students, postdocs, research technicians, etc.), students should clearly and specifically describe their contribution to the project.
- **1 cr:** Submit a written report that summarizes the work assigned work performed. The student should demonstrate the background of the problem, the research techniques/tools used for the project, and the results obtained from the work along with a minimum of statistical analysis.
- **2 cr:** In addition to the instructions above, students should demonstrate their contributions to problem solving or trouble-shooting difficulties in the project (e.g., demonstration of prototyping and redesign as a result of testing and analysis).
- **3 cr:** In addition to the instructions above, students should also demonstrate the ability to design aspects of the experiments and/or protocols for the projects including statistical design of all testing protocols. The written report should also include recommendation for future directions.
- The instructor of record for the BME 696 section will be a regular faculty member. In cases where the Advanced BME Project sponsor (main instructor) is an adjunct faculty, non-BME faculty, or external sponsor, a regular BME faculty member will serve as the instructor of record to help guide the external main instructor adhere to the aim and spirit of the course and help in the assessment and assignment of the student's course grade.

Guidelines for BME 69600 Evaluations:

- **Report language:** The summary report should be written in scientific language with appropriate citations. Students are encouraged to seek professional assistance on the structure and writing of the report.
- **Report length:** The length of the report should be appropriate to the level (i.e., credit hour) of the effort.
- **Critical evaluation:** With the assistance from the instructor, students will be trained to develop original critical evaluation.
- **Problem solving:** Students are not required to propose original ideas and solutions for the scientific/engineering problems. However, they should provide logical evolution and correlation between the scientific/engineering problem and the potential solutions.
- **Grade recommendation:** The course grade for the student will be assigned by the instructor based upon the participation of the student in the project and the quality of the report based upon the guidelines above. Reports will be submitted to the BME Graduate Committee at the end of the semester. The Graduate Committee will scan the report for plagiarism, and assess the quality of the report and course grade assigned by the instructor against the course expectations and the above guidelines. Feedback will be given to the instructor of record to ensure consistency of scoring and quality across BME 696 sections. Feedback, in particular to adjunct faculty, external sponsors, and junior faculty (< 3 years in the department) will play an important role in establishing consistency in the scoring of BME 696 across sections.

Grades should be assessed in terms of degree of meeting expectations laid out per the number of course credit hours, above. The degree of meeting expectation, evidenced by the report should be assessed against the following descriptors: A = Excellent, B = Very Good, C = Fair, D = Poor, F = Failure. Please note that Graduate students are expected to maintain a cumulative B grade on courses on their Plan of Study to graduate from the program.

Appendix B. Help with Plan of Study (GS-6) for a Master of Science in BME

A few helpful suggestions include:

1. Mark **(X)** Thesis or Non-Thesis Option on the plan.
2. List a total of 7 courses and arrange the courses into two separate groups. Group courses in the Primary area first followed by the group of courses in the Related area. Consult with your advisor on the Primary and the related area courses. For each of the courses listed designate “**P**” for Primary and “**R**” for Related under the column for Area on the far left column. Do not include Master of Science Research Thesis credits.
3. For the column labeled “**Date Completed or to be Completed**”, only the month and year is required. There is no need to include a specific date of completion.
4. For the column labeled “**Regular Registration**”, a check indicates that this particular course was or will be completed after official admission to graduate program, i.e., courses taken following admission to the IUPUI Graduate School AND the graduate program in BME.
5. For the column labeled “**Non-degree Regis**”, a check indicates that this particular IUPUI course was completed as a non-degree graduate student BEFORE being admitted into the BME program.
6. The column labeled “**Other or Transfer From**” refers to those courses taken at another institution that are to be transferred to the Plan of Study. The name of the institution (other than IUPUI) which offered the courses must be recorded. This is required for Purdue graduate courses taken at a campus other than IUPUI as well as all online course offerings from Purdue (e.g., via the Engineering Professional Education online program) and requires prior approval from the student's Advisory Committee. In addition, had the student started a Master of Science degree program in a department at IUPUI other than BME (e.g., Biology) and decided to switch to BME, the course(s) completed in the Biology department would also be considered transfer courses and must be indicated as such in the “**Other or Transfer From**” column. Similarly, this also applies to graduate courses taken as an undergraduate, that are not applied to any undergraduate degree program.

With respect to item #6: Reminder that **it is a rule for all Master of Science degree programs in the Purdue system that no more than 12 graduate credit hours can be transferred onto a Plan of Study** from an outside institution or some other IUPUI graduate degree program (for example, Biology in the example above).

Appendix C. Sample Plans of Study (GS-6): Non-Thesis and Thesis