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Biomedical Engineering Faculty and Staff

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<tr>
<th>Name</th>
<th>Title</th>
<th>Office</th>
<th>Email Address</th>
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<tbody>
<tr>
<td>Sean J. Kirkpatrick</td>
<td>Department Chair &amp; Professor</td>
<td>Room 301</td>
<td><a href="mailto:sjkirkpa@mtu.edu">sjkirkpa@mtu.edu</a></td>
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<tr>
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<tr>
<td>Graduate School Committee:</td>
<td>Feng Zhao, Jingfeng Jiang, Sangyoon Han</td>
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</tr>
<tr>
<td>Stacey Sedar</td>
<td>Departmental Coordinator</td>
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<tr>
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<td>Assistant Professor</td>
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<td><a href="mailto:sjhan@mtu.edu">sjhan@mtu.edu</a></td>
</tr>
<tr>
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<td><a href="mailto:jjiang1@mtu.edu">jjiang1@mtu.edu</a></td>
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<tr>
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</tr>
<tr>
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<td>Room 306</td>
<td><a href="mailto:rupakr@mtu.edu">rupakr@mtu.edu</a></td>
</tr>
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<td>Assistant Professor</td>
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<td><a href="mailto:smithar@mtu.edu">smithar@mtu.edu</a></td>
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<td>Professor of Practice</td>
<td>Room 406</td>
<td><a href="mailto:osoykan@mtu.edu">osoykan@mtu.edu</a></td>
</tr>
<tr>
<td>Graduate Student</td>
<td>Ami Kling</td>
<td></td>
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<td>Government Representative:</td>
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Departmental Assessment Plan

At the end of the Biomedical Engineering PhD program, students will be able to:

<table>
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<tr>
<th>Learning Goals</th>
<th>Measures</th>
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<tr>
<td>Demonstrate mastery of the subject matter.</td>
<td>Graduate course grades</td>
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<td>Qualifying Exam</td>
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<td></td>
<td>Research Proposal</td>
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<td></td>
<td>Dissertation and Defense</td>
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<td></td>
<td>PhD Self-assessment</td>
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<td>Demonstrate advanced research skills; design and execute a research project</td>
<td>Research Proposal</td>
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<td>and conduct original and publishable research in the field.</td>
<td>Dissertation and Defense</td>
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<tr>
<td>• Master application of existing methodologies and techniques.</td>
<td>PhD Self-assessment</td>
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<tr>
<td>• Critically analyze and evaluate one’s own findings and those of others.</td>
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<tr>
<td>Make an original and substantial contribution to the discipline.</td>
<td>Research Proposal</td>
</tr>
<tr>
<td>• Think originally and independently to develop concepts and methodologies.</td>
<td>Dissertation and Defense</td>
</tr>
<tr>
<td>• Identify new research opportunities within one’s field.</td>
<td>PhD Self-assessment</td>
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<td>Conference presentations</td>
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<td>Doctoral Candidate Seminar</td>
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<td>Demonstrate professional skills.</td>
<td>Qualifying Exams</td>
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<td>• Effective oral communication skills.</td>
<td>Research Proposal</td>
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<tr>
<td>• Effective written communication skills.</td>
<td>Dissertation and Defense</td>
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<td>• Graduate Teaching</td>
<td>PhD Self-assessment</td>
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<td>Conference presentations</td>
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<td>GTA evaluations</td>
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<tr>
<td>Practice responsible conduct of research.</td>
<td>Research Proposal</td>
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<td>Dissertation and Defense</td>
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<td>PhD Self-assessment</td>
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<td>Conference presentations</td>
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<td>RCR Training</td>
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<td>GTA evaluations</td>
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Biomedical Engineering Doctoral Admission Process

Applications must be received by the admissions deadline to receive support from the Department of Biomedical Engineering (BME) PhD program:

- Fall semester admission: PhD application deadline is **January 15**.

- Spring semester admission: PhD application deadline is **July 1**. *However, most applicants are awarded support for the fall semester, very few applicants are awarded support for the spring semester.*

Applications submitted after the deadline will be considered on a rolling basis. **For full consideration of support, applications should be submitted by the deadline.**

Support letters will be sent to applicants prior to the start of the semester.

**Admission Requirements:**

Applicants that meet the required criteria are not guaranteed an acceptance into the program.

- GPA of 3.25 on a 4.0 scale

- To convert your GPA to the 4.0 scale, please use this link: [GPA Calculator](#)

- GRE: Recommended scores of 85% (*Michigan Tech students are exempt*)
  - 165 Quantative
  - 153 Verbal
  - 3.0 Analytical

- TOEFL: Recommended Score of 110 iBT (*International Students*)

- IELTS: Recommended Overall Band Score of 8.0 (*International Students*)

The graduate committee will review applications approximately biweekly and reject any applications that do not meet the basic requirements.

The applications that were not rejected will be sent to department faculty. Faculty will review applications and identify applicants with mutual research interests. Applicants whose statement of purpose poses a mutual research interest will be approved for acceptance into the program (this final approval does not indicate funding will be received). The applicant will be temporarily paired with the faculty member for advising.
Choosing an advisor:
PhD students are assigned a temporary advisor upon their acceptance into the Biomedical Engineering Graduate Program. Students must choose an advisor prior to the end of the first semester and submit the Advisor and Committee Recommendation Form to the department and Graduate School.

Keys, Desk, Computers, and Research Space Assignments:
See office staff at front desk in M&M 309 for office assignment, computer and keys.

See your advisor for appropriate lab training and workspace.

Mail Service, Photocopier, Supplies, and Printers:
Copy machine, printers, and campus mail boxes are located in the main M&M 309 office.

International Students:
Please refer to the International Programs and Services website for helpful information.

University Student Policies:
The following links from the Graduate School website explain University Student Policies:

Academic Standards
- Appeals of Suspension or Dismissal
- Attendance Policy
- Exam Policies
- Good Academic Standing and Dismissal
- Scholastic Standards

Course and Credit Policies
- Adding and Dropping a Course
- Bills, Due Dates, Refunds, and Payment Plans
- Credit Hours and Expectations
- Enrollment Policies and Full-Time Status
- Full-Time Course Listing
- Medical (Voluntary and Involuntary) and University Withdrawal
- Research Mode (also see department guidelines)
- Reusing Credits
- Transfer, MIGS, and Senior Rule Credits

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- Degree Requirements (also see department guidelines)
- Dissertations, Theses, and Reports (also see department guidelines)
- Holds FAQ
- Graduation, Certification, and Commencement
- Tracking and Status Forms

Financial Policies

- Assistantships
- CGS Resolution Regarding Graduate Scholars, Fellows, Trainees, and Assistants
- Federal Financial Aid
- Fellowships
- Financial Aid Policies
- Minimum Stipend Rates

Professional Conduct

- Academic Integrity
- Conduct Policies
- Consensual Relationships

Student Support and Health Insurance

- Disability Services and Policies
- Grievances: Dean of Students | Graduate School
- Health Insurance Policy and Information
- Medical Withdrawal: Voluntary | Involuntary
- Parental Accommodation

Biomedical Engineering Requirements and Deadlines

Each PhD student enrolled in the Department of Biomedical Engineering (BME) PhD program is required to adhere to the following requirements and deadlines. Students requiring additional coursework will be notified of any required prerequisites as determined by the student’s advisor and/or BME graduate program director.

REMEMBER THAT FORMS ARE AVAILABLE ON THE GRADUATE SCHOOL WEBSITE, MyMichiganTech AND THE BIOMEDICAL ENGINEERING WEBSITE.

STUDENTS ARE REQUIRED TO MONITOR THEIR ACCOUNTS AND SUBMIT FORMS BY THE REQUIRED DEADLINES.

Continued next page.
Newly accepted student responsibilities upon arrival on campus and prior to 1st day of class:

Obtain Husky Card

International students report to International Programs and Services (IPS)

Attend Graduate School Orientation

- Complete Basic Responsible Conduct of Research Training:
  - Provided during Graduate School Orientation Or
  - Basic RCR Training
- Complete on MyMichiganTech the Patent, Research, & Proprietary Rights Agreement Form
- Submit official proof of previous degrees earned to the Graduate School

Attend BME Department Graduate Student Orientation Meeting.

Meet with your temporary assigned advisor to discuss which courses to enroll in.

Biomedical Engineering Academic Timeline:

Beginning of 1st semester:

- Complete Campus Clarity Training
- Complete Advisor & Committee Recommendation Form and submit to the Graduate School. A copy of the document is also required for department files. This process is to confirm who the advisor will be. Students may choose to change their assigned advisor at this time.

2nd semester:

- Complete Advisor & Committee Recommendation Form and submit to the Graduate School prior to the end of the semester. (Post Master’s students only.) A copy of the document is also required for department files. This process is to choose an advisory committee. The committee will consist of the student’s advisor, and at least 3 additional full-time faculty members. Two members must have a primary appointment in the BME department. There must be at least one member who does not have a primary appointment in the BME department.

- Proposed coursework: Biomedical Engineering Plan of Study Form. The proposed coursework will include the classes taken during the first semester. This must be signed by the advisor. This form is for department files only.

2nd – 3rd semester:

- Complete Advanced Responsible Conduct of Research Training
  - Students are recommended to take these courses fall or spring semester

Continued next page.
3rd - 6th semester: (completion of coursework)

- **One semester of GTA**
- **Proposal Defense**
  - Provide date, time, building/room number and proposal title to departmental coordinator.
- Submit [Qualifying Exam](#) and [Research Proposal Exam](#) to the department. Staff enters into BANNER.
- Submit Evaluation Rubrics to the department. (These will be provided to you at the appropriate time)
- Submit Petition to [Enter Research Mode](#) to the Graduate School
- Submit [Degree Schedule](#) to the Graduate School
- **All PhD students will be required sometime during their study (prior to their defense) to present a seminar to BME faculty and other BME graduate students. Two students will be selected per semester. Discussions with selected students will occur early in the semester to allow presenting students time to prepare their seminar.**

4th semester:

- Complete Advisor & [Committee](#) Recommendation Form and submit to the Graduate School prior to the end of the semester. *(Post Bachelors students only.)* A copy of the document is also required for department files. This process is to choose an advisory committee. The committee will consist of the student’s advisor, and at least 3 additional full-time faculty members. Two members must have a primary appointment in the BME department. There must be at least one member who does not have a primary appointment in the BME department.

Every semester:

- *Must attend a minimum of 6 BME graduate seminars each semester. Attendance of other department seminars is required if there are not enough BME seminars offered.***

At the end of every semester:

- Submit Graduate Student Self-assessment Form to advisor at the end of each semester/prior to the beginning of the next semester. (This form will be sent to student by office staff).
- Arrange meeting with advisor to review the self-assessment
- The purpose of the self-assessment is to keep the advisor abreast of progress and garner their feedback. The advisor may determine if more frequent meetings are required. This also provides graduate students with a review of their performance and expectations for the coming semester. Negative reviews will reflect in the graduate student’s grade.

**SEMESTER OF PLANNED DEGREE COMPLETION:**

Students need to monitor their MyMichiganTech account for required [Graduate School forms and deadlines](#).

6th - 10th Semester:

- Submit [Degree Completion Form](#) to the Graduate School

Continued next page.
Defense of research proposal presentation (dissertation defense):

2 weeks prior to defense:

- Provide date, time, building/room number and defense title to departmental coordinator. M&M 309 staff can reserve a room for the defense.
- Submit Pre-defense Form & Defense Draft to the Graduate School and advisory committee. Committee members may request to have the defense draft turned in sooner.

On the day of the defense:

- Bring a copy of the Report on Final Oral Examination Form and Evaluation Rubrics (provided by office staff) to the defense
- The dissertation defense is open to the public. The student will give a presentation to the audience. The general audience will first question the student on the proposal. Upon dismissal of the general audience, the committee members will continue to question the student. The committee will evaluate the student’s ability to present and defend the dissertation. If the student does not pass the defense, he/she can retake the defense a second time. Failure in the second defense will result in the student’s dismissal from the PhD program.

Please refer to the Graduate School guidelines for remaining procedures at:

Theses dissertation policies and procedures or MyMichiganTech

Staff at the front desk will send you a departmental Exit Interview to complete before you leave the university.
# Grad School/BME Doctoral Timeline

## Before you arrive on campus:
1. Arrange for housing
2. Consult with your assigned BME advisor for course selection
3. International students must submit arrival information on MyMichiganTech to notify International Programs and Services (IPS)

## Upon arrival on campus:
1. Obtain Husky Card
2. International students report to IPS

## Prior to 1\textsuperscript{st} week of class:
1. Attend Graduate School Orientation
2. Complete Basic Responsible Conduct of Research Training
3. Complete Patent, Research, & Proprietary Rights Agreement Form on MyMichiganTech
4. Submit official proof of previous degrees earned to the Graduate School
5. Attend BME Grad Student Orientation

## Beginning of 1\textsuperscript{st} semester:
1. Submit Advisor Recommendation Form to the Graduate School
2. Complete Campus Clarity Training

## Every year:
1. Provide proof of health insurance or pay University policy
2. Obtain parking permit
3. Attend BME GTA meeting if teaching

## Every semester:
1. Register for courses
2. Pay tuition bill
3. Confirm enrollment
4. Attend required graduate seminars

## At the end of every semester:
1. Submit Self-assessment Form to advisor

## Prior to the end of the 2nd semester PM/4th semester PB:
1. Submit Advisory Committee Form to the Graduate School
2. Complete BME Plan of Study Form

## 2\textsuperscript{nd} or 3\textsuperscript{rd} semester:
1. Complete Advanced Responsible Conduct of Research Training

## 3\textsuperscript{rd} – 5\textsuperscript{th} semester:
1. Complete GTA

## 4\textsuperscript{th} semester PM/6\textsuperscript{th} semester PB: (Proposal Defense)
1. Provide date, time, building/room number and proposal title to departmental coordinator. M&M 309 staff can reserve a room.
2. Pass Qualifying Exam and Research Proposal Exam submit to department to enter in BANNER

## Semester coursework is complete or before entering research mode:

## 4\textsuperscript{th} semester PM/6\textsuperscript{th} semester PB
1. Submit Degree Schedule to the Graduate School

## 1 week prior to beginning of semester you wish to enter research mode:
1. Submit Petition to Enter Research Mode to the Graduate School

Continued next page.
Graduate School/BME Doctoral Timeline - Continued

Semester of planned degree completion (6th semester PM/10th semester PB):

1. Present a seminar for BME graduate students and faculty

10 weeks prior to commencement:

1. Submit Commencement Application Form to the Graduate School
2. Submit Degree Completion Form to the Graduate School

4 weeks (PM) 6 weeks (PB) prior to defense:

1. Plan for defense: schedule date, time, and room with advisor committee and department. (M&M 309 staff can reserve a room.)
2. Provide date, time, building/room number and title of defense to departmental coordinator.

2 weeks prior to defense:

1. Submit Pre-defense Form and Defense Draft to the Graduate School and advisor committee

Defense date:

1. Defend and bring a copy of Report on Final Oral Examination Form Evaluation Rubrics

Post – defense (refer to deadlines on Graduate School web-site)

1. Submit Approval of Dissertation, Report, or Thesis Form to the Graduate School

Within 1 week of submitting Approval Form and by semester deadline MONDAY OF WEEK 14:

1. Submit Thesis/Report to Digital Commons and ProQuest

Biomedical Engineering Plan of Study Form

Student Name: _____________________________  M #: _________________  Date: ______________

List of courses to be counted toward PhD Degree

<table>
<thead>
<tr>
<th>Title</th>
<th>Course Number</th>
<th>Number of Credits</th>
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</table>

Approval signatures: ___________________________________________ Advisor: _______________________

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BE6900 Biomedical Engineering Doctoral Topics

Title of topic/project: __________________________________________________________

# of credits: ________ BE6900 will receive a letter grade.

Student Name: ____________________________ M# ________________

Faculty Approval:

_________________________ ___________________________ Date: __________

Printed Signature

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Instructions for changing your advisor

This process is for when you wish to change your advisor after the Advisor and Committee Recommendation Form was already submitted to the Graduate School.

Before initiating the process to change your graduate advisor, please consider all the options listed on the Graduate School’s website for how to address difficulties in the student-advisor relationship:

Once you have decided to change your graduate advisor, you must follow the steps listed below.

1. Meet with your graduate program director to initiate the process to change advisor. If meeting with the graduate program director is not feasible or appropriate, meet with the Chair or School Dean of the department or school. If you are in a non-departmental program, you may meet with the Chair or School Dean of your administrative home department or school.

2. Discuss the following with the graduate program director (or Chair/School Dean) and, if appropriate, the current advisor:
   - Whether additional resources within or outside the department (such as the Ombuds office) could help resolve the situation.
   - The impact of the change of advisor on your time to complete the degree. Coursework, qualifying exam(s), and the research proposal examination are all factors that could be impacted with a change in advisor.
   - Your current and future funding.
   - Research already conducted. Whether this will be incorporated into the dissertation, thesis, or report, and if so, how.
   - Impact on immigration status (if any). Consult International Programs and Services (IPS), if necessary.
   - Complete the BME Change of Advisor form and record the agreement from the discussions in writing, including indications of agreement from all affected faculty advisors, and provide copies to the student, the graduate program director, and all affected faculty advisors.
     File an updated Advisor and Committee Recommendation Form for approval by the Graduate School.

3. If the student and the graduate program director are unable to reach agreement on the advisor change, contact the assistant dean of the Graduate School to determine additional steps to resolve the situation.
Change of Advisor Form

1. Student’s justification for changing advisor:

2. Current advisor comments:

Continued next page.
3. Future advisor comments:

4. Grad Committee comments:

Student Name (printed): ___________________________ Student Signature: ___________________________ Date: ___________________________

Current Advisor (printed): ___________________________ Current Advisor Signature: ___________________________ Date: ___________________________

Future Advisor (printed): ___________________________ Future Advisor Signature: ___________________________ Date: ___________________________

Grad Committee: ___________________________ Signatures: ___________________________ Date: ___________________________

Feng Zhao ___________________________________________ ___________________________ ___________________________

Jingfeng Jiang ___________________________________________ ___________________________ ___________________________

Sangyoon Han ___________________________________________ ___________________________ ___________________________

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BME PhD Coursework Requirements

Coursework Requirements:

A total of 60 credit hours of coursework, research credits, and at least 1 semester of teaching are required prior to graduation. A minimum of 24 credits of coursework, with a minimum cumulative GPA of 3.25, must be completed while enrolled in the BME PhD program at MTU to be eligible for the qualifying examination and research proposal examination. A minimum of 12 credits of coursework must be from the BME department.

The following courses are required core courses, all students must take and pass with a minimum of a “B” grade. Students will be required to re-take the course with grades less than “B”:

- MA5701 Statistical Methods I offered Fall
- BE5200 Cellular & Molecular Biology II offered Spring OR KIP 5500 Systems Physiology offered Fall

The Graduate School allows up to six credits of BC/C to count toward a degree, the department will accept up to six credits as long as the course is not one of the required core courses.

All graduate students must attend the BME graduate seminars. See the separate section Graduate Seminar Series for further information.

There is potential for a waiver of the core courses if students from universities other than MTU have taken graduate level courses and received a satisfactory GPA. Waivers will be granted at the discretion of the advisor.

Student’s coursework must be approved by their advisor, BME graduate program director, and/or BME department chair. Coursework requirements will vary by individual student based on his or her background.

Graduate students who wish to take 3000 or 4000 level courses must get special approval from their advisor.

Requirements for Students with Non-Engineering Degrees:

In addition to students with BS or MS engineering degrees, the BME department also accepts qualified students from non-engineering programs. To ensure success of these students in the program, students with non-engineering degrees will need to demonstrate proficiencies in mathematics and engineering knowledge. Deficiencies in engineering topics will be determined by their advisor and BME graduate program director. The requirement to fulfill these deficiencies can be accomplished with the following options.

- **Courses:** Students need to take specific courses to fulfill the engineering requirement. The exact courses will depend on the student’s deficiencies. The number of credits and courses will be determined by the student’s advisor (and advisory committee, if applicable), and approved by the BME graduate program director. These extra credits can be counted towards the credit requirement for the degree up to 9 credit hours if the courses are 3000 levels or higher.

- **Independent Projects:** If a student does not have the proper engineering background in a certain area, he/she can enroll in an independent study/project advised by a faculty with the appropriate expertise, and approved by the BME graduate program director. The independent project can be counted towards the credit requirement for the degree. See BE6900 Biomedical Engineering Doctoral Topics
Graduate Seminar Series

Attendance of all Biomedical Engineering Graduate Seminars is required.

PhD students are required to present a seminar to BME faculty and BME graduate students.

Faculty attending the PhD student’s seminar will use the Biomedical Engineering PhD Evaluation Rubric and record the results on the Biomedical Engineering Evaluation of PhD Graduate Student Outcomes – Seminar.

The department coordinator will email notifications about the date, time, and location for seminars that will occur (a seminar will not be held every week so please watch your email closely).

Requirements:

- All graduate students MUST attend all Biomedical Engineering seminars.
  - There will be a sign in sheet at the seminar to ensure attendance.
- Graduate students must attend 6 seminars per semester (emails are sent from the department coordinator announcing other departmental seminars as well). If the BME department does not hold 6 seminars per semester, students must attend seminars from other departments.
  - BME PhD proposal defense, dissertation defense and MS Thesis/Report defense are considered to be part of the seminar series.
- Graduate students must write up a brief summary of each seminar attended. They must have their advisor approve and sign the summary and then turn it in to staff at the front desk.
- Failure to attend the appropriate number of seminars will result negatively on student’s evaluations that occur each semester and will negatively impact their research grade.

Events that are not acceptable for seminar assessments:

- Seminars that are not a scientific or technical research topic
- Webinars
- Graduate School workshops or training sessions
- PhD proposal defense, dissertation defense and MS Thesis/Report defense outside of the BME department
- Conferences
- Tech Talk Series

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Graduate Seminar Assessment Form

Student Name: ________________________________ Date: ______________________

Title of Seminar attended: __________________________________________________________

Name of Seminar Presenter: ________________________________

Summary of Seminar:

Advisor Signature: ________________________________________________ Date: ____________

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Biomedical Engineering Fall Semester Graduate Courses

**REQUIRED CORE COURSE: MA 5701 - Statistical Methods** Introduction to design, conduct, and analysis of statistical studies, with an introduction to statistical computing and preparation of statistical reports. Topics include design, descriptive, and graphical methods, probability models, parameter estimation and hypothesis testing.

**Credits:** 3.0 Lec-Rec-Lab: (0-3-0)

**Semesters Offered:** Fall and Spring

**BE 5000 - Biomedical Masters Research** Includes the study of an acceptable biomedical engineering problem and the preparation of a report or thesis.

**Credits:** variable to 12.0; May be repeated; Graded Pass/Fail Only

**Semesters Offered:** Fall, Spring, Summer

**BE 5330 - Biomimetic Materials** This course introduces students to biologically inspired approaches to design functional biomaterials. Topics include the discovery and incorporation of biological designs into novel materials and their application in the biomedical field.

**Credits:** 3.0 Lec-Rec-Lab: (3-0-0)

**Semesters Offered:** Fall - Offered alternate years beginning with the 2014-2015 academic year.

**BE 5335 - Smart Polymers** This course introduces students to smart polymers that change their physical properties in response to various environmental stimuli. Topics include the molecular origin of the stimuli responsiveness of these materials and their application in the biomedical field.

**Credits:** 3.0 Lec-Rec-Lab: (3-0-0)

**Semesters Offered:** Fall - Offered alternate years beginning with the 2015-2016 academic year.

**BE 5350 - Cell Biomechanics and Mechanical Transduction** This course is designed to introduce the mechanical analysis and characterization of mammalian cells. Mechanotransduction, whereby cells detect loading and respond to the morphology and mechanical properties of the surrounding extracellular matrix, will be emphasized.

**Credits:** 3.0 Lec-Rec-Lab: (3-0-0)

**Semesters Offered:** Fall
BE 5390 - Scientific Computing Offers insight into advanced scripting, parallel computing with traditional CPUs and hardware accelerators, data analysis, and visualization. Students will get hands-on experience in designing, building, securing, managing, and using a HPC cluster in compliance with federal regulations.

**Credits:** 3.0 **Lec-Rec-Lab:** (3-0-0)

**Semesters Offered:** Fall, Spring

BE 5510 - Cardiovascular Engineering Fundamental cardiovascular pathology and the biomedical engineering approaches being developed and used toward problems resulting in significant cardiovascular deficiency such as myocardial infarction, chronic kidney disease, atherosclerosis, and heart valve disease.

**Credits:** 3.0 **Lec-Rec-Lab:** (3-0-0)

**Semesters Offered:** Fall

BE5670 – Micro & Nano Technologies This course introduces students to micro- & nano- technologies and the processes involved in their manufacturing. Particular emphasis will be on the use in biomedical applications. Goal is to provide beneficial research and development to the industry.

**Credits:** 3.0

**Semesters Offered:** Fall

BE 5755 - Medical Devices An introduction to medical devices used for diagnosis, monitoring, and treatment in clinical medicine. Topics covered include product planning, reliability, clinical trial design, regulatory as well as technical aspects of common medical devices.

**Credits:** 3.0 **Lec-Rec-Lab:** (3-0-0)

**Semesters Offered:** Fall

BE 5850 - Tissue Mechanics This course integrates continuum mechanics, experiments and computational methods to understand soft tissue mechanics. The first half of the course is dedicated to building continuum mechanics foundation, which will be used to formulate constitutive equations for arteries and the heart in the second half.

**Credits:** 3.0 **Lec-Rec-Lab:** (3-0-0)

**Semesters Offered:** Fall

BE5900 – Biomedical Engineering Master’s Topics Biomedical engineering courses will be offered as professional electives dependent upon the interest of the faculty.

**Credits:** variable to 6.0; May be repeated

**Semesters Offered:** Fall, Spring, Summer

Continued next page.
BE5930 section 11 - Computer Vision for Microscopic Images. This course involves how to quantify data out of images typically from optical microscopes

**Credits:** 3.0 **Lec-Rec-Lab:** (0-1-2)

**Semesters Offered:** Fall - Offered alternate years beginning with the academic year 2019-2020

BE6000 – Biomedical Engineering Doctoral Research Includes the study of an acceptable biomedical engineering problem and the preparation of a report or thesis.

**Credits:** variable to 12.0; May be repeated; Graded Pass/Fail Only

**Semesters Offered:** Fall, Spring, Summer

BE 6900 - Biomedical Engineering Doctoral Topics Biomedical engineering courses will be offered as professional electives dependent upon the interest of the faculty.

**Credits:** variable to 6.0; May be repeated

**Semesters Offered:** Fall, Spring, Summer

**REQUIRED CORE COURSE:** KIP 5500 - Systems Physiology A comprehensive systemic study of the physiological functions of the adult human, including an introduction to the underlying etiologies and clinical indicators of molecular, cellular, and tissue bases for common organ system diseases in humans.

**Credits:** 3.0

**Semesters Offered:** Fall

(This course can be taken in place of BE5200 Cellular and Molecular Biology II, which is offered every spring.)

**REQUIRED CORE COURSES MUST HAVE A GRADE OF “B” OR BETTER. STUDENTS WILL BE REQUIRED TO RE-TAKE THE COURSE WITH GRADES LESS THAN “B”.

These courses are offered fall semester by the department. If your faculty advisor has recommended you take courses that are 3000 or 4000 level, you must see the staff in M&M 309 for a waiver to take these courses.

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Biomedical Engineering Spring Semester Graduate Courses

**BE 5000 - Biomedical Masters Research** Includes the study of an acceptable biomedical engineering problem and the preparation of a report or thesis.

**Credits:** variable to 12.0; May be repeated; Graded Pass/Fail Only

**Semesters Offered:** Fall, Spring, Summer

**BE 5115 - Finite Element Modeling** The course teaches both fundamentals of finite element theory and hands-on experience for bio-engineers.

**Credits:** 3.0 **Lec-Rec-Lab:** (3-0-0)

**Semesters Offered:** Spring

**REQUIRED CORE COURSE: BE 5200 - Cellular and Molecular Biology II** Covers, at an advanced level, the general principles and engineering applications of science and biology, including cell biology, physiology, molecular biology, genetics, and biotechnology.

**Credits:** 3.0 **Lec-Rec-Lab:** (3-0-0)

**Semesters Offered:** Spring

**OR**

**KIP 5500 - Systems Physiology** A comprehensive systemic study of the physiological functions of the adult human, including an introduction to the underlying etiologies and clinical indicators of molecular, cellular, and tissue bases for common organ system diseases in humans.

**Credits:** 3.0

**Semesters Offered:** Fall

*(This course is offered every fall and can be taken in place of BE5200 Cellular and Molecular Biology II.)*

**BE 5230 – Stem Cell and Tissue Engineering** This course will introduce (1) basic concepts of tissue engineering, (2) scaffold materials and biotechnologies for tissue engineering, (3) basic concept of stem cells, (4) review of stem cell sources and related policies, (5) current progress in stem cell research, (6) application of stem cells in tissue engineering and regenerative medicine.

**Credits:** 3.0 **Lec-Rec-Lab:** (3-0-0)

**Semesters Offered:** Spring

Continued next page.
**BE 5250 - Biomedical Optics** Light plays a significant role in modern clinical diagnostics and in the clinical treatment of disease. Examples include non-invasive surgery, optical biopsy, and cancer therapy. This course will focus on the study of how light propagates through biological tissue.

**Credits:** 3.0 **Lec-Rec-Lab:** (3-0-0)

**Semesters Offered:** Spring - Offered alternate years beginning with the 2014-2015 academic year.

**BE 5390 - Scientific Computing** Offers insight into advanced scripting, parallel computing with traditional CPUs and hardware accelerators, data analysis, and visualization. Students will get hands-on experience in designing, building, securing, managing, and using a HPC cluster in compliance with federal regulations.

**Credits:** 3.0 **Lec-Rec-Lab:** (3-0-0)

**Semesters Offered:** Fall, Spring

**BE5410 – Medical Imaging** This course covers the physical nature of the interactions between the waves and matter, especially the biological tissues, principle imaging modalities used in modern medicine and the common techniques used for the processing of the resulting images.

**Credits:** 3.0

**Semesters Offered:** Spring – Offered alternate years beginning with the 2018-2019 academic year.

**BE5900 – Biomedical Engineering Master’s Topics** Biomedical engineering courses will be offered as professional electives dependent upon the interest of the faculty.

**Credits:** variable to 6.0; May be repeated

**Semesters Offered:** Fall, Spring, Summer

**BE5930 section 9 – Engineering & Applied Conservation.** This course will introduce students to current and future conservation practices. Students will learn how to assess and address conservation problems through the development of engineering technology.

**Credits:** 3.0 **Lec-Rec-Lab:** (3-0-0)

**Semesters Offered:** Spring

**BE6000 – Biomedical Engineering Doctoral Research** Includes the study of an acceptable biomedical engineering problem and the preparation of a report or thesis.

**Credits:** variable to 12.0; May be repeated; Graded Pass/Fail Only

**Semesters Offered:** Fall, Spring, Summer
**BE 6900 - Biomedical Engineering Doctoral Topics** Biomedical engineering courses will be offered as professional electives dependent upon the interest of the faculty.

**Credits:** variable to 6.0; May be repeated

**Semesters Offered:** Fall, Spring, Summer

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**REQUIRED CORE COURSE: MA 5701 - Statistical Methods** Introduction to design, conduct, and analysis of statistical studies, with an introduction to statistical computing and preparation of statistical reports. Topics include design, descriptive, and graphical methods, probability models, parameter estimation and hypothesis testing.

**Credits:** 3.0 Lec-Rec-Lab: (0-3-0)

**Semesters Offered:** Fall and Spring

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**REQUIRED CORE COURSES MUST HAVE A GRADE OF “B” OR BETTER. STUDENTS WILL BE REQUIRED TO RE-TAKE THE COURSE WITH GRADES LESS THAN “B”.

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These courses are offered spring semester by the department. If your faculty advisor has recommended you take courses that are 3000 or 4000 level, you must see the staff in M&M 309 for a waiver to take these courses.
Self-assessment

- Completed after each semester for PhD students.
- Completed annually by Master’s students.
- Both the student and advisor need to complete sections on the assessment.
- Assessments will contain written feedback and must be discussed during a meeting between the advisor and student and then signed and dated.
- A printed copy will be provided to the student and kept in the departmental files.
- In the event that serious deficiencies are identified, they must be clearly identified in the Self-assessment advisor expectations with a plan to remedy the deficiencies.

The Self-assessment forms will be sent to students as a fillable pdf by office staff.

ASSESSMENT FORMS MUST BE COMPLETED ELECTRONICALLY AND CANNOT BE FILLED OUT BY HAND.

Student:
You will receive a fillable pdf form from office staff.
Download the file.
Complete all questions pertaining to student information.
Choose “save as” and rename the file with your first and last name.
Prepare an updated Curriculum Vitae.
Send your CV and Self-assessment to your advisor to complete.
You should arrange to meet with your advisor to discuss, sign, and date the Self-assessment.

Advisor:
You will receive a fillable pdf from your grad student.
Download the file.
Complete all questions pertaining to advisor information.
Save and print the file.
The completed Self-assessment should be discussed, signed and dated at the meeting with your student.
Turn in the completed Self-assessment to office staff for department files. Students will receive a copy of their Self-assessment for their records.
Research Proposal Exam and Qualifying Exam

The student needs to pass the research proposal exam and the qualifying exam to become a PhD candidate and enter Research Mode. A minimum of 24 credits of coursework, with a minimum cumulative GPA of 3.25 is required to be eligible.

- The exam must be scheduled before the beginning of the 3rd year (5th semester) of the PhD program.
- The exam should be scheduled 3 weeks prior to the exam date.
- Students can pick up a Proposal Defense packet from the front desk with instructions for the defense process.
- Provide the date, time, building/room number and proposal title to the departmental coordinator. M&M 309 staff can reserve a room.
- The advisory committee needs to select a chairperson to oversee the exam. The chairperson must be a primary BME faculty member. The advisor shall only serve as an observer during the exam process.
- If a student fails a portion of the exam, he or she must retake the failed portion of the exam within a year. A student that fails either portion of the exam 2 times will be dismissed from the program.

Research Proposal Exam and Qualifying Exam: This is a public presentation of the student’s research proposal to the advisory committee covering the background, hypotheses, aims, goals, preliminary data, and experimental methods of the proposed research for their defense dissertation (this constitutes the research proposal exam). After the presentation the student’s advisory committee meets with the student alone to ask the student questions (this constitutes as the qualifying exam section). Both exams will also serve to test the student’s basic knowledge of the research topic. The research proposal exam and qualifying exam are typically performed on the same day, one immediately following the other.

- The student must provide each committee member the abstract and scope of the research proposal no later than 3 weeks prior to their Exam. The written research proposal must follow the full research proposal guidelines of a federal funding agency (NIH, NSF, DoD, etc.). The final proposal must be submitted to each committee member 2 weeks before the exams.

- The proposal presentation is open to the public. The student will give a presentation (45 minute maximum) to the audience covering the background, hypotheses, aims, goals, preliminary data, and experimental methods of the proposed research. The general audience and committee members will question the student on the proposal.

- Based on the feedback from the entire audience, the committee will evaluate the student’s ability to present and defend a reasonable and technically sound research plan using the Biomedical Engineering PhD Evaluation Rubric and record the results on the Biomedical Engineering Evaluation of PhD Graduate Student Outcomes – Research Proposal and Biomedical Engineering Evaluation of PhD Graduate Student Outcomes – Qualifying Exam.

- Approval of the research proposal exam and qualifying exam may come upon successful completion of the proposal presentation and question session or may require additional meetings with the committee and the approval of another separate oral qualifying exam covering basic research topics discussed with the advisory committee. Approval must be made within a year of the proposal presentation or the student will be dismissed from the program.
Petition to Enter Research Mode

A student is eligible for Research Mode after successfully completing all required coursework and passing the qualifying exam and research proposal exam. The Research Mode Petition, with the Degree Schedule if not previously submitted, must be submitted to the Graduate School 1 week prior to the 1st day of the semester.
Dissertation and Dissertation Defense

A dissertation is the culmination of a research project. Students must prepare their document using the guide found on the Graduate School website.

Students can pick up a Dissertation Defense packet from the front desk with instructions for the defense process.

The final oral dissertation defense may be scheduled using the Pre-defense Form found on the Graduate School website. This form requires a date, time and building/room number for the defense. Students must provide this information along with the title of the defense to the departmental coordinator before or at the same time the Pre-defense Form is submitted. Staff in M&M 309 can reserve a room for the defense.

All defenses must be scheduled two weeks in advance of the desired date. Students must submit the complete defense draft of their dissertation to the Graduate School and also to their advisor and committee two weeks before their defense. The deadline to submit a committee approved post-defense dissertation, thesis or report is 4:00 p.m. on the Monday of week 14.

There is a grace period from Tuesday of week 14 to Wednesday 4:00 p.m. of the week before classes begin for the next semester. Students who submit their dissertation, thesis, or report will qualify to enroll in UN5951 in the upcoming semester. These students will pay the resubmission fee (25% of one-credit of tuition) when their documents are accepted.

The dissertation defense is open to the public. The student will give a presentation to the audience. The general audience will first question the student on the proposal. Upon dismissal of the general audience, the dissertation committee members will continue to question the student. The committee will evaluate the student’s ability to present and defend the dissertation based on the Biomedical Engineering PhD Evaluation Rubric and record the results on the Biomedical Engineering Evaluation of PhD Graduate Student Outcomes – Dissertation & Defense. If the student does not pass the defense, he/she can retake the defense a second time. Failure in the second defense will result in the student’s dismissal from the PhD program.

Upon completion of the oral dissertation defense, students should make any technical corrections requested by their advisor and committee and also any formatting corrections from the Graduate School. Print the Approval of Dissertation, Thesis or Report Form from the Graduate School website and obtain signatures from advisor and all committee members. The completed form must be submitted to the Graduate School. Within one week and prior to the deadline, submit the final dissertation to the Graduate School (see the website for submission instructions). The deadline to submit a final dissertation is Monday of week 14 of the semester.