GRADUATE HANDBOOK

Department of Bioengineering

2023-2024 Academic Year

Northeastern University

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Table of Contents

Appendix

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1. General Information

Welcome to the Department of Bioengineering ("BioE") at Northeastern University! This document provides information for current and prospective students about graduate programs in the Department of Bioengineering, College of Engineering, Northeastern University. Graduate students are expected to read this document, be familiar with the rules and procedures, follow them, and refer to this guide when they have questions. Please reach out to relevant department faculty or staff with any questions, comments or concerns. You may also e-mail listen2bioestudents@coe.neu.edu with program feedback. For further support on course registration, student records, academic standing, graduation or other general queries, reach out to coe-bioe-gradadvising@northeastern.edu.

1.1 Graduate Programs and Degrees

The BioE Department offers two main graduate programs, a Master of Science (MS) in Bioengineering and Doctor of Philosophy (PhD) in Bioengineering. MS and PhD degree programs are only offered as full-time programs (for guidelines regarding Industrial PhD, please see Appendix G). Qualified applicants with a BS or MS degree in bioengineering or related fields can apply to our graduate programs.

1.2 Department Safety Training

All PhD and MS students who plan to perform laboratory research are required to complete the basic Department of Bioengineering laboratory safety training program, in addition to any lab-specific safety training. To avoid delays in performing research, new students are strongly advised to complete this training in the first month following matriculation. The list of required online and in-class courses is provided in **Appendix A** of this handbook. For more information, please contact the department Lab Safety Officer Kathryn Lasseter (k.lasseter@northeastern.edu).

1.3 Forms for Graduate Studies

Please use this link to access the following forms: *PhD Advisor Declaration Form*, *PhD Lab. Rotation Form, Dissertation Committee and Proposal Defense Form*, and the *Independent Study Project Plan Form*. These forms can also be found in the Appendix section.

Please use this link for all Graduate School of Engineering Forms, including course petition forms, registration override forms, credit transfer forms, and academic probation forms.

1.4 Graduate Student Support

The Bioengineering department is committed to fostering a welcoming and supportive community. In addition to the wellbeing resources and support offered by the Graduate School of Engineering, students are encouraged to reach out to a department representative with any questions or concerns for support and advice. We encourage students to reach out as and when issues arise, as often problems are much easier to solve early on.

Departmental first point of contact: Academic Operations Manager - Caroline Pridmore
Additional contacts:
Graduate Student Council

- Representatives - Joshua Pace, Ana Vargas, Ashley Herrick
- Faculty Advisor - Samuel Chung

Department staff:

- Senior Business Manager - Esther Cohen

MS Program Contact: Michael Jaeggli
PhD Graduate Development Committee:

- Chiara Bellini, Sara Rouhanifard, Guohao Dai, Elizabeth Libby

2. Bioengineering Master of Science – Overview and Program Concentrations

Students accepted to the Master of Science in Bioengineering program have three concentrations from which to choose:

- Concentration 1: Biomedical Devices and Bioimaging
- Concentration 2: Cell and Tissue Engineering
- Concentration 3: Biomechanics
- Concentration 4: Systems, Synthetic, and Computational Bioengineering

A study concentration is required for every MS student. Each concentration has required courses and a list of technical electives. Students should select two to five courses, depending on the concentration, and whether he or she selects the thesis option, project option, or course-only option (please consult the detailed requirements for each concentration).

2.1 MS Concentrations

Biomechanics

Students who join the biomechanics concentration will cover multiscale mechanics, including whole-body movement, mechanical properties of biomaterials, and fluid mechanics of physiological fluids. All biomechanics concentration students must complete two of the following courses: Multiscale Biomechanics (BIOE 5650), Musculoskeletal Biomechanics (ME 5665), Physiological Fluid Mechanics (BIOE 5630), and Computational Biomechanics (BIOE 5640).

Biomedical Devices and Bioimaging

The biomedical devices and bioimaging concentration is appropriate for students interested in the design of biomedical devices, as well as biomedical imaging and signal processing. Three courses are required for all students in this concentration, Design of Biomedical Instrumentation (BIOE 5810), Design, Manufacture, and Evaluation of Medical Devices (BIOE 5250), and Biomedical Imaging (BIOE 5235).

Cell and Tissue Engineering

The cell and tissue engineering concentration is appropriate for students interested in molecular, cell, and tissue engineering. Two courses are required for all cell and tissue engineering students, Molecular Bioengineering (BIOE 5410) and Cellular Engineering (BIOE 5420). There is an extensive list of approved technical electives to choose from to complete the degree.

Systems, Synthetic, and Computational Bioengineering

This concentration covers topics including statistical physics, statistical inference, dynamical and stochastic modeling, execution and analysis of quantitative experimentation, machine learning, and control and information theory. These techniques are taught in the context of biological applications, such as gene regulation, differentiation and cancer, epigenetics, the microbiome, memory and learning, and synthetic genetic circuits. The concentration includes a lab course, BIOE 5710. Required courses are BIOE 5710 and BIOE 5720, and one of BIOE 5115 or BIOE 5750.

2.2 Detailed MS Program Course Requirements

The following sections explain the course requirements for students entering the bioengineering Master Program. A total of 32 semester hours (SH, 1 SH is roughly equivalent to 45 hours of learning) and a minimum 3.0 GPA are required to complete the MS degree. In addition to the core courses for each MS student, each concentration has its own course requirements (see below).

Required Core Courses (All Concentrations)

BIOE 7390 Seminar	0 SH
BIOE 6100 Medical Physiology	4 SH
BIOE 6000 Principles of Bioengineering	1 SH

Concentration Specific Requirements

Complete requirements for *one of the four* MS concentrations as follows:

MS Concentration 1 – Biomechanics (28 SH)

Required Course Work (**8 SH**)

A grade of C or higher is required.

Complete two of the following courses:

BIOE 5630	Physiological Fluid Mechanics
BIOE 5640	Computational Biomechanics
ME 5665	Musculoskeletal Biomechanics
BIOE 5650	Multiscale Biomechanics

and one of the following:

i) Coursework Option (**20 SH**)

Complete 20 SH from the course list (see below).

ii) Project Option **(20 SH)**

BIOE 7890	Master's Project	**4 SH**

+ Complete 16 SH from the course list. **16 SH**

iii) Thesis Option **(20 SH)**
Complete the following (repeatable) course twice:
BIOE 7990 Thesis **8 SH**
+ Complete 12 SH from the course list. **12 SH**

Concentration Electives Course List:

BIOE 5115	Dynamical Systems in Biological Engineering
BIOE 5440	The Cell as a Machine
BIOE 5630	Physiological Fluid Mechanics
BIOE 5640	Computational Biomechanics
BIOE 5650	Multiscale Biomechanics
BIOE 5820	Biomaterials
	(or CHME 5631 Biomaterials Principles and Applications)
BIOL 5601	Multidisciplinary Approaches in Motor Control
CHME 5632	Advanced Topic in Biomaterials
EECE 7200	Linear Systems Analysis
EECE 7203	Complex Variable Theory and Differential Equations
ME 5665	Musculoskeletal Biomechanics
ME 5650	Advanced Mechanics of Materials
ME 5654	Elasticity and Plasticity
ME 5655	Dynamics and Mechanical Vibration
ME 5657	Finite Element Method
ME 5658	Continuum Mechanics
ME 5659	Control Systems Engineering
ME5665	Musculoskeletal Biomechanics
ME 7238	Advanced Finite Element Method

MS Concentration 2 – Biomedical Devices and Bioimaging (28 SH)

Required Course Work (**12 SH**)
A grade of C or higher is required.

BIOE 5235	Biomedical Imaging
or BIOE 5648	Biomedical Optics
BIOE 5250	Design, Manufacture, and Evaluation of Medical Devices
BIOE 5810	Design of Biomedical Instrumentation

and one of the following:

i) Coursework Option (**16 SH**)
Complete 16 SH from the course list (see below).

ii) Project Option **(16 SH)**
BIOE 7890 Master's Project **4 SH**
+ Complete 12 semester hours from the course list. **12 SH**

iii) Thesis Option **(16 SH)**
Complete the following (repeatable) course twice:
BIOE 7990 Thesis **8 SH**
+ Complete 8 SH course works from the elective course list. **8 SH**

Concentration Electives Course List:

BIOE 5115	Dynamical Systems in Biological Engineering
BIOE 5510	Bioengineering Products/Technology/Commercialization
BIOE 5648	Biomedical Optics
BIOE 5800	Systems, Signals, and Controls for Bioengineers
BIOE 5820	Biomaterials (or CHME 5631 Biomaterials Principles and Applications)
BIOE 5850	Design of Implants
CHME 5632	Advanced Topics in Biomaterials
EECE 5606	Micro- and Nanofabrication
EECE 7105	Optics for Engineers
EECE 7200	Linear Systems Analysis
EECE 7203	Complex Variable Theory and Differential Equations
EECE 7204	Applied Probability and Stochastic Processes
ME 5657	Finite Element Method
NNMD 5274	Nanomedicine Seminar 2
NNMD 5370	Nanomedicine Research Techniques

MS Concentration 3 - Cell and Tissue Engineering (28 SH)

Required Course Work (**8 SH**)

A grade of C or higher is required.

BIOE 5410	Molecular Bioengineering
or BIOE 5411	Applied Molecular Bioengineering
BIOE 5420	Cellular Engineering

and one of the following:

i) Coursework Option (**20 SH**)

Complete 19-20 SH from the course list (see below).

ii) Project Option

BIOE 7890	Master's Project	**4 SH**
+ Complete 15-16 SH from the course list.		**15-16 SH**

iii) Thesis Option

Complete the following (repeatable) course twice:

BIOE 7990	Thesis	**8 SH**
+ Complete 11-12 SH from the course list.		**11-12 SH**

Concentration 2 Electives Course List:

BIOE 5115	Dynamical Systems in Biological Engineering
BIOE 5250	Design, Manufacture, and Evaluation of Medical Devices
BIOE 5430	Principles and Applications of Tissue Engineering
BIOE 5440	The Cell as a Machine
BIOE 5450	Stem Cell Engineering
BIOE 5510	Bioengineering Products/Technology Commercialization
BIOE 5820	Biomaterials (or CHME 5631 Biomaterials Principles and Applications)
BIOL 5543	Stem Cells and Regeneration
BIOL 6301	Molecular Cell Biology

CHME 5632	Advanced Topics in Biomaterials
ME 5667	Solid Mechanics of Cells and Tissues
NNMD 5370	Nanomedicine Research Techniques
NNMD 5470	Nano/Biomedical Commercialization: Concept to Market

MS Concentration 4 – Systems, Synthetic, and Computational Bioengineering (28 SH)

Required Course Work (12 SH)
A grade of C or higher is required.
Complete the following courses (8 SH)

BIOE 5710	Experimental Systems and Synthetic Bioengineering
BIOE 5720	Physical Bioengineering

Complete one of the following courses (4 SH)

BIOE 5115	Dynamical Systems in Biological Engineering
BIOE 5750	Modeling and Inference in Bioengineering

and one of the following:

i) Coursework Option **(16 SH)**
Complete 16 SH from the course list (see below).

ii) Project Option **(16 SH)**

BIOE 7890	Master's Project	4 SH
+ Complete 12 SH from the course list.		12 SH

iii) Thesis Option **(16 SH)**
Complete the following (repeatable) course twice:

BIOE 7990	Thesis	8 SH
+ Complete 8 SH from the course list.		8 SH

Concentration 4 Electives Course List:

BINF 6400	Genomics in Bioinformatics
BIOE 5115	Dynamical Systems in Biological Engineering
BIOE 5440	The Cell as a Machine
BIOE 5510	Bioengineering Products/Technology Commercialization
BIOE 5640	Computational Biomechanics
BIOE 5750	Modeling and Inference in Bioengineering
BIOE 5760	Method and Logic in Systems Biology and Bioengineering
BIOE 5860	Engineering Approaches to Precision Medicine I
BIOE 5870	Engineering Approaches to Precision Medicine II
BIOE 5880	Computational Methods in Systems Bioengineering
BIOL 6299	Molecular Cell Biology for Biotechnology
CHEM 5638	Molecular Modeling
CHME 5630	Biochemical Engineering
DS 5110	Introduction to Data Management and Processing
DS 5220	Supervised Machine Learning and Learning Theory
DS 5230	Unsupervised Machine Learning and Data Mining

HINF 5101	Introduction to Health Informatics and Health Information Systems
PHSC 6290	Biophysical Methods in Drug Discovery
PHTH 5202	Introduction to Epidemiology
PHYS 5116	Complex Networks and Applications

2.3 MS Program Thesis Option Requirements

For MS students choosing the Thesis Option, he/she must find a thesis advisor and complete 8 SH of BIOE 7990 (Thesis). This is usually done in two semesters, with each semester 4 SH, but can also be done in one semester for 8 SH. If a student has completed 8 SH of BIOE 7990, but has not yet defended their thesis, he/she must enroll in BIOE 7996 (Master's Thesis Continuation, 0 SH) until they successfully defend their thesis.

When a student is ready to defend their thesis, they must form a "Thesis Committee" in consultation with their advisor. The Committee must have at least three members, and at least two of whom must be tenured or tenure-track BIOE faculty. After successful defense of one's thesis, a letter grade will be assigned to BIOE 7990 (Master's Thesis) by the student's advisor. Students should adhere to Graduate School of Engineering deadlines and after defending, initiate the MS Thesis signature page. Deadlines and the Thesis Signature Form can be found here.

The date and location of an MS thesis defense must be announced at least one week before the date of the defense - please reach out to the BioE Academic Operations Manager to arrange this. Please provide the following details:

- Date, start time, finish time
- Location or, if you would like department assistance with booking, preferred location and expected capacity
- Zoom link if planning a hybrid or virtual presentation
- Title and Abstract, and confirmation of committee members

An MS student taking the thesis option may graduate once he/she has successfully defended their MS thesis, and fulfilled all course requirements. To graduate, a student must attain a cumulative grade-point average (GPA) of 3.0 or higher in all courses. A student must also earn a grade of "C" or higher in all required core courses.

2.4 MS Program Project-Option Requirements

For MS students choosing the Project Option, he/she must find a project advisor and complete 4 SH of BIOE 7890 (MS Project).

When an MS student has completed the MS project, they must write a Project Report. The report must be submitted to the student's project advisor and obtain their approval. The approved Project Report will be archived by both the BIOE Department as well as the project advisor.

An MS student taking the project option can graduate once he/she has obtained their Project advisor's approval of the Project report and fulfilled all course requirements. To graduate, one must have a cumulative GPA of at least 3.00 with a grade of "C" or higher in all required core courses.

2.5 Graduate Certificate Options

Students enrolled in an MS degree have the opportunity to also pursue one of the many engineering graduate certificate options in addition to or in combination with the MS degree. Students should consult their faculty advisor regarding these options.

Gordon Institute of Engineering Leadership

Master's Degree in Bioengineering with Graduate Certificate in Engineering Leadership
Students may complete an MSin Bioengineering in addition to earning a Graduate Certificate in Engineering Leadership. Students must apply and be admitted to the Gordon Engineering Leadership Program in order to pursue this option. The program requires fulfillment of the 16-semester-hour-curriculum required to earn the Graduate Certificate in Engineering Leadership, which includes an industry-based challenge project with multiple mentors. The integrated 33-SH degree and certificate will require 17 hours of advisor-approved bioengineering technical courses.

3. Bioengineering PhD – Overview and Research Areas

Students pursuing a PhD degree through the Department of Bioengineering are expected to complete required coursework (**Section 3.1**) and perform cutting-edge research (**Section 3.2**) under the guidance of a primary advisor, and sometimes additional co-advisors, identified from our core and affiliated faculty. The Department features four research areas as listed below. Students should consult the Bioengineering Research Map for more information about BioE faculty conducting research in these areas.

PhD Research Area 1: Biomedical Devices and Bioimaging (BDBI)

The Biomedical Devices and Bioimaging track reflects Northeastern University's outstanding research profile in developing transformative and translational instrumentation and algorithms to help understand biological processes and disease. Our department has active federally funded research spanning across a broad spectrum of relevant areas in instrument design, contrast agent development, advanced computational modeling and reconstruction methods. Example research centers include the Institute for the Chemical Imaging of Living Systems (CILS), the Translational Biophotonics (TBP) Cluster, and the B-SPIRAL signal processing group

PhD Research Area 2: Biomechanics, Biotransport and MechanoBiology (BBMB)

Motion, deformation, and flow of biological systems in response to applied loads elicit biological responses at the molecular and cellular levels that support the physiological functions of tissues and organs and drive their adaptation and remodeling. To study these complex interactions, principles of solid, fluid, and transport mechanics must be combined with measures of biological functions. The Biomechanics, Biotransport, & Mechanobiology track embraces this approach and leverages the strong expertise of Northeastern faculty attempting to tie applied loads to biological responses at multiple length and time scales.

PhD Research Area 3: Molecular, Cell, and Tissue Engineering (MCTE)

Principles for engineering living cells and tissues are essential to address many of the most significant biomedical challenges facing our society today. These application areas include engineering biomaterials to coax and enable stem cells to form functional tissue or to heal damaged tissue; designing vehicles for delivering genes and therapeutics to reach specific target cells to treat a disease; and, uncovering therapeutic strategies to curb pathological cell behaviors and tissue phenotypes. At a more fundamental level, the field is at the nascent stages of understanding how cells make decisions in complex microenvironments and how cells interact with each other and their surrounding environment to organize into complex three-dimensional tissues. Advances will require combinations of multiscale experimental, computational and theoretical approaches spanning across molecular-cellular-tissue levels and integration of molecular and physical mechanisms, including the role of mechanical forces.

PhD Research Area 4: Systems, Synthetic, and Computational Bioengineering (SSCB)

Research groups in Systems, Synthetic, and Computational Bioengineering apply engineering principles to model and understand complex biological systems, including differentiation and development, pathogenesis and cancer, and learning and behavior. This involves designing and

implementing methods for procuring quantitative and sometimes very large data sets, as well as developing theoretical models and computational tools for interpreting these data.

Deciphering the workings of a biological system allows us to identify potential biomarkers and drug targets, to develop protocols for personalized medicine, and more. In addition, we use the design principles of biological systems we discover to engineer and refine new synthetic biological systems for clinical, agricultural, environmental, and energy applications.

3.1 PhD Course Requirements

The following sections explain the course requirements for students entering the Bioengineering PhD program with a BS degree as well as students entering with a Master's degree ("Advanced Entry"). The normal course-load for PhD students is 8-9 semester hours (SH) per semester (roughly 2 regular courses). In addition to coursework, students must complete the qualifying, proposal, and PhD defense exam sequence described in detail in Section 3. All PhD students are expected to maintain regular research progress for timely completion of their PhD, verified by satisfactory reviews in their annual individual development plans (AIDP).

A student must attain a cumulative grade-point average (GPA) of 3.0 or higher in all courses applied toward that degree and exclusive of any prerequisite courses required of students admitted provisionally to their program. A student must also earn a grade of "C" or higher in all required core courses (courses must be retaken in the event of attainment below a "C").

3.1.1 Students Entering with BS Degrees

Students entering the Bioengineering PhD program with a BS will take a total of 8 courses (32 SH): three core bioengineering courses (12 SH), two restricted bioengineering technical electives (8 SH), and three unrestricted technical electives (12 SH). Those courses choices are outlined below:

I. Required Core Courses (12 SH):

BIOE 6100 Medical Physiology
BIOE 6200 Mathematical Methods in Bioengineering
BIOE 7000 Principles of Bioengineering

II. Restricted Technical Electives (8 SH):

BIOE 5115 Dynamical Systems in Biological Engineering
BIOE 5235 Biomedical Imaging
BIOE 5410 Molecular Bioengineering
BIOE 5411 Applied Molecular Bioengineering
BIOE 5420 Cellular Engineering
BIOE 5430 Principles and Applications of Tissue Engineering
BIOE 5440 The Cell as a Machine
BIOE 5630 Physiological Fluid Mechanics
BIOE 5648 Biomedical Optics
BIOE 5650 Multiscale Biomechanics

BIOE 5710	Experimental Systems and Synthetic Bioengineering
BIOE 5720	Physical Bioengineering
BIOE 5750	Modeling and Inference in Bioengineering
BIOE 5810	Design of Biomedical Instrumentation
BIOE 5820	Biomaterials
ME 5665	Musculoskeletal Biomechanics

III. Unrestricted Technical Electives (12 SH) and Independent Study:

Any 3 courses on our master list of approved technical electives. This list can be found on the Course Catalog, and suggestions by research area are also included in **Appendix B**. Some unrestricted BIOE electives may be petitioned to count as a restricted elective. Other courses may be taken by petition and with approval of PhD Advisor and PhD director, including up to 8 SH of Independent Study* (BIOE 7978).

Independent Study

Independent Study (BIOE 7978) requires department approval and a petition form. It must be completed with a non-dissertation advisor faculty in different areas of research in our department. A course outline agreed upon between faculty and student must be submitted to and approved by the Department of Bioengineering Associate Chair for Research and PhD Programs and Academic Operations Manager prior to enrolling.
To request an independent study, please fill out the BIOE 7978 Independent Study Project Plan, following the steps outlined on the form.

IV. Professional Development Courses (0 SH):

Complete the following (repeatable) courses, 2 semesters each.

BIOE 7390	Seminar (enrolled in at least two semesters)
BIOE 7391	Student Seminar (2nd and 4th years)

V. Dissertation (0 SH):

Complete the following two courses:

BIOE 9990	Dissertation Term 1
BIOE 9991	Dissertation Term 2

After achieving PhD candidacy by passing the qualifying exam, the doctoral candidate, in consultation with his or her research advisor, must register in two consecutive semesters (may include full summer term) for Dissertation Term 1 (BIOE 9990) and Dissertation Term 2 (BIOE 9991). Upon completion of this sequence, the student must then register for Dissertation Continuation (BIOE 9996) in every semester they are receiving funding) until the dissertation is completed. Students may not register for Dissertation Continuation (BIOE 9996) until they fulfill the two-semester sequence of Dissertation Term 1 (BIOE 9990) and Dissertation Term 2 (BIOE 9991).

For PhD students who have completed the majority of their course work but not yet reached PhD candidacy, a zero-credit course, Research (BIOE 9986) or Exam Preparation—Doctoral (BIOE 8960), can be taken if needed to fulfill the full-time course registration requirement. These are) individual instruction coursed, billed at 1 SH, and graded S or U. These courses do not have any course content, and students must register in a section for which their research advisor is listed as the "instructor." If your instructor' section does not exist, you will need to submit an Individual Instruction Registration form or reach out to the department Academic Operations Manager to request for one to be created.

Please note that Exam Preparation cannot be taken more than two times; otherwise, students can take Research (BIOE 9986) to maintain full time enrollment prior to achieving candidacy.

3.1.2 Advanced Entry Students

The curriculum for PhD students with advanced standing will be selected from the available core and elective courses under the guidance of the student's primary advisor, the Associate Chair for Graduate Studies (PhD Program Director) and Academic Operations Manager. The advanced standing PhD degree requires a minimum of 16 semester hours (SH) of course work to be approved by the graduate director and a completed PhD dissertation. Advanced standing constitutes receipt of a relevant and accepted master's degree at a qualified institution. Examples of "relevant degrees" include MS degrees in various Engineering domains, including, but not limited to, Mechanical, Chemical, Biomedical, Electrical and Computer Engineering; examples of MS degrees that are not considered relevant include prior MS degrees in art, history, literature, finance, etc.

I. Required Courses (8 SH):

BIOE 7000	Principles of Bioengineering	(required for students Fall 2023 onwards)
BIOE 6200*	Mathematical Methods in Bioengineering	(required for students Fall 2023 onwards)

II. Electives (8 SH):

Advisor-approved coursework made up of a combination of the following: Electives listed on the Course Catalog/Appendix B Independent Study (BIOE 7978)	8 SH
Seminar (register and complete two semesters)	0 SH
Student Seminar (register and complete two semesters)	0 SH
Dissertation 1 and Dissertation 2 (in consecutive semesters)	0 SH
Minimum semester hours required	16 SH

The Master List of approved technical electives is included in **Appendix B**. A list of suggested courses by research area is also included. Electives for Advanced Entry students may be replaced with up to 12 SH of relevant independent studies courses - Independent Study (BIOE 7978) - by petition.

*Advanced Entry students may request to **waive** BIOE 6200 if they demonstrate sufficient Math background. In this case students should email the BioE Associate Chair for PhD Programs and the BIOE 6200 course instructor, providing detail on suitable mathematical background, and **undergraduate and graduate transcripts showing Math courses taken**. If approved, students will file a petition form to waive and replace this core course.

3.1.3 Professional Development Course Requirements

The Bioengineering department holds weekly PhD student work-in-progress (WIP) seminars to give students opportunities to present their research to the department. Students are required to minimally present twice throughout the PhD program. The recommended timing of these WIP presentations is to present once in the second year, and another one in the fourth year. Each seminar consists of a 25-minute presentation with 5 minutes for questions from the audience.

Students should enroll in a dedicated course "Student Seminar" (BIOE 7391) only in the semesters they are expected to present, i.e. in their second and fourth years when contacted by the department for scheduling. The department Academic Operations Manager will contact students when they are due to present. A grade of S or U will be assigned by the PhD Program Director at the end of the semester.

We want to highlight that the primary goal of the PhD student seminars is to give students practice in clear and concise oral communication of research to an audience of **educated non-specialists**.[1] This is an essential skill for anyone seeking a career in scientific research and beyond. This differs from that of a group meeting or a conference presentation, which are given to audiences of fellow specialists who are already familiar with the field and its specialized terminology. Rather, students will be presenting to a diverse, interdisciplinary group of peers (i.e. the Bioengineering Department and other members of the Northeastern community). A prior familiarity with the area of research therefore cannot be assumed.

By nature, students in their 2nd year will focus on reviewing their area of research and discussing their planned research directions (as opposed to presenting original research). In contrast, students in their 4th year will focus on presenting their dissertation work.

Students should also make every effort to present their research in a way that is accessible to people who are listening rather than viewing. For example, instead of telling the audience "as you can see on this graph", one should describe clearly what the graph shows.

A secondary goal of the seminar series is to enrich the intellectual environment of the Department of Bioengineering. Students should take the opportunity to attend all seminars and to develop familiarity with research outside of their own groups and research areas.

[1]Some text adapted from: https://medbio.utoronto.ca/graduate-student-seminars

3.2 PhD Research Requirements

In addition to coursework (**Section 3.1**), completion of the PhD degree requires students to successfully complete all the research related requirements listed below. An example timeline for a PhD student entering with a BS degree is listed in **Section 3.3**

3.2.1 PhD Laboratory Rotation

All PhD students who are funded by Bioengineering (Dean's) Fellowship or Teaching Assistant (TA) at the time of entry into the program are required to complete a rotation in a *minimum of two* department research laboratories. At least one of the two rotations must be performed in the laboratory of a core Bioengineering faculty member. Your **first rotation is required to be with a core Bioengineering faculty member.**

Students should make an appointment to speak with potential research advisors and confirm their willingness to advise and potentially provide financial support to a student via research assistantship (RA) following the rotation. Potential advisors may be found through the Department website, through the Bioengineering Research Map, through the Department Research Fair in September, and by meeting with the PhD Program Director or any member of the faculty Graduate Development Committee.

Students should complete the PhD Laboratory Rotation Form (**Appendix C**) and return it to the department Academic Operations Managerprior to each lab rotation.

The rotation timeline is as follows (for students with a September/Fall matriculation):

September:	Complete Department Safety Training (**Section 1.2**, **Appendix A**) and identify labs for rotation
October-December:	First Lab rotation
January-March:	Second Lab Rotation

3.2.2 Advisor declaration and performance probation policies

I. Finding and Declaring a Research Advisor

Completion of the research dissertation component of the PhD degree requires that a student selects and formally declares a research advisor. To do this, the PhD Research Advisor Declaration Form (Appendix D) is completed, signed by the student and the advisor, and filed with the Academic Operations Manager of the Bioengineering Department. The research advisor can be any tenured, tenure-track, research, teaching, or affiliated Bioengineering faculty. All PhD students must have a research advisor within one calendar year after their matriculation at NU; otherwise, their status changes to MS course-only track. If, after a change of status, these students can find a research advisor, their status will be reset to PhD.

Choosing a research advisor that is a mutually "good match" is perhaps one of the most important decisions a PhD student will make. This is typically done on the student's initiative, before or within the first semester of joining the PhD program. Students should plan to meet with prospective advisors, determine their willingness to take on new students, and ask about research in their labs. Example questions a student might ask in this meeting to determine the potential fit are:

- *Are you taking on new students in your group?*
- *Do you have a specific project in mind? If so, is that project currently funded by a research grant?*
- *What other projects are going on in this group? Are all the students in your group funded?*

- *What are the most important skills to be successful in your group?*
- *Would you be able to support me on a research assistantship?*
- *How often do you meet with your students 1-on-1?*
- *Do you have regular lab meetings? Journal club?*
- *Do you normally pair a student up with a senior student?*
- *How big is your group? How many MS, PhD, Postdocs?*
- *Are you a 'hands on' advisor? If not, who would I go to for help?*
- *Can I meet with one of your current grad students?*
- *What journals does your group normally publish in?*
- *What conference does your group regularly attend?*
- *What is your policy on sending students to conferences?*
- *What are your expectations for graduation for a PhD in terms of research output?*

II. Transition Periods: Changing Labs and Research Probation

A PhD student should have a primary advisor, either at the time of entry to the program (when admitted as a research assistant) or shortly after completion of lab rotations. Except for lab rotations, any period of time that a PhD student does not have a primary advisor is referred to as the "transition period". In unfortunate cases, a student may experience more than 1 transition period throughout their study, however, the maximum duration for each transition period should not exceed 6 months and multiple transition periods must have a minimum spacing of no less than 6 months. If a student fails to re-declare a new advisor 6 months into the transition period, their status automatically changes to MS course-only track or dismissal from the PhD Program.

If a student is experiencing difficulties in their current lab, they are strongly encouraged to reach out to the Bioengineering PhD Director, or Academic Operations Manager, for support and to discuss options before making a firm decision.

The start of the transition period may be triggered by one of the 3 below events:

1. a PhD student may elect to change research advisor partway through their PhD studies,
2. an advisor may initiate a research probation due to unsatisfactory performance and the student under probation failed to complete the mutually agreed action plan, and
3. a student completed the maximum number of allowed rotations and failed to join a lab.

In the first scenario, if a student decides to leave a lab, before doing so, the student must speak with the Bioengineering PhD Director or Academic Operations Manager. A formal written communication must be sent by the student or PhD Director to the student's advisor to inform the decision. The student must identify and re-declare a research advisor within 6 calendar months of this meeting, or within 6 calendar months of leaving their previous lab (whichever comes sooner). The student should identify a rotation lab by the end of the second month, complete a Lab Rotation Allocation Form with the rotation PI and submit the form to the Academic Operations Manager.

In rare cases, the PhD advisor may also elect to terminate the advisee relationship partway through their PhD studies due to unsatisfactory performance. The advisor must first provide detailed written warning to the student to start a "performance probation" period, with a minimum length of 4 months. This written warning (either by email or AIDP review) must, i) explain the nature of the deficiency, ii) define a 4 month "action plan" by which the student may demonstrate acceptable progress to continue mentorship. The action plan is effective when approved by the Bioengineering PhD Director. During the probation period, the primary advisor of the student remains unchanged (thus probation period and transition period are not overlapping), therefore, the primary advisor is still responsible for mentoring and supporting the student. However, if the student fails to make sufficient progress to address the communicated deficiencies within the probation period, then the student loses their primary advisor and enters the transition period. In some cases, a student may elect to leave the lab, as in scenario 1 above, during the probation period. This also triggers the start of the transition period. The student should provide written notice of this decision to both the advisor and the Bioengineering PhD Director, and this decision must be made by the end of the first month of the research probation.

Similarly, for any student entered the program without an advisor, including Bioengineering Fellows and Teaching Assistants, the student is required to complete lab rotations in the first 2 semesters of their study, identify and declare a research advisor by the end of their second semesters. Please note that Summer 1 and Summer 2 combined are equivalent to one full semester. When necessary, a third rotation is permitted to allow a student to explore additional options. If a rotation student fails to join any lab by the end of the second semester after matriculation, the student also enters the transition period.

Any student in a transition period should discuss the forms of possible financial support with the Department of Bioengineering Associate Chair for Research and PhD Programs and the Business Manager. In principle, funding support is not guaranteed. In certain extraneous situations, our department has limited TA slots that may be allocated to support some of these students, but such funding is not guaranteed and a student must have sufficient technical background to be considered for a TA position for a course that is available at that time.

3.2.3 Annual Individual Development Plan (AIDP) Student Review

The College of Engineering conducts yearly student evaluations in the form of Annual Individual Development Plan (AIDP) review, usually performed in the Spring semester of each year. The purposes of the AIDP/Annual Review are to: i) summarize student academic achievements in the prior calendar year, ii) outline student goals for the present calendar year, and iii) obtain formal written feedback and evaluation from their advisory committee. The AIDP must be discussed with a student's advisor prior to submission.
All PhD students are required to complete the AIDP reporting process with their advisor by the specified deadline. Specific instructions and deadlines will be provided by the college annually.

If a student fails to submit the AIDP report before the reporting deadline for the College, an automatic "unsatisfactory" decision may be assigned by the department. An unsatisfactory AIDP review, either concluded by the student's advisor, or by the Department results in a "performance probation". An official probation letter will be sent by the College to notify the respective student. In addition, failing to provide sufficient detail on the AIDP can lead to an unsatisfactory review, therefore leading to a probation period.

3.2.4 Qualifying Exam (written and oral)

Please refer to **Appendix E** for full information: policies, committee information, format, exam timeline, and grading rubric.

In order to maintain academic standing in the PhD Program, students must pass a comprehensive qualifying examination in one of the four department research areas to demonstrate preparedness to perform doctoral research and eventually complete a satisfactory PhD dissertation. The qualifying exam is normally taken in the student's second year in the program. In order to take the exam, students must demonstrate satisfactory research progress (as reported by their research advisor) and satisfactory academic standing (as indicated by their GPA). The exam includes written and oral components. Students will prepare a 6-page written document in the format of an NIH R21 proposal (as detailed below). This document needs to demonstrate creative thinking and should be focused on the subject of the student's own PhD thesis research and relevant topics at the laboratory where the thesis work will be performed. The oral portion of the exam will involve a presentation by the student of their written proposal and defense of the ideas included within. This exam will assess students' critical thinking, understanding of the fundamental background of their research, and ability to create a logical and rational experimental plan using engineering design principles. The qualifying exam does not require the student to have preliminary data, although presenting relevant preliminary data for explaining the proposed study is permitted and considered helpful.

Plagiarism, i.e. including verbatim copies or slightly modified text from written materials published by others without appropriate citation, is considered severe academic misconduct and is strictly forbidden in all academic works at Northeastern, including qualifying exam reports. The exam committee actively performs plagiarism checks to verify the originality of the report. Any verified plagiarism activities discovered in the written report may automatically result in a failure of the exam, or, in severe cases, discharge from the PhD program.

3.2.5 PhD Dissertation Committee

Within two years of joining the Bioengineering PhD program, students shall form their Dissertation committee. The committee should be composed of at least three Northeastern University members. The chair of the committee should be the student's primary advisor or a member of the Bioengineering core faculty. Two members of the committee must be core faculty from the Bioengineering Department. At least one committee member must be outside of the Department of Bioengineering; it is highly recommended to have an External Faculty member from another university or institute to serve as a member of the committee. Once students have formed their committees, they should complete the PhD Dissertation Committee Form (**Appendix F)** and file it with the Academic Operations Manager of the department. Students will be required to meet with their PhD Dissertation Committee at least **annually** to document sufficient research progress. A more frequent meeting schedule and active interactions with the Dissertation Committee members is highly recommended.

3.2.6 DissertationCommittee Meetings and Dissertation Proposals

A PhD student's first committee meeting also serves as the Dissertation Proposal Defense in the Bioengineering Department. Prior to their first committee meeting, a student is required to write a research plan, outlining aims and objectives for their research in the form of an NIH-style R21 research plan, to be distributed to all committee members no later than 1 week prior to the

meeting. Research progress update meetings must be held annually after the proposal. At the second to last meeting, held at least **four months** before the Dissertation Defense, the student must prepare a Thesis Completion Proposal and present this proposal to the thesis committee in order to obtain "permission to write" their final dissertation. The student will be allowed to progress to the PhD Dissertation Defense upon successful defense of this proposal. Students must complete their first Dissertation Committee Meeting (i.e. Dissertation Proposal Defense) no later than their third year except special circumstances (require approval by the graduate development committee).

Committee Meeting Outline for the Path to Dissertation Defense:

Timing	Event
Year 2	● Pass Qualifying Exam ● Begin forming Dissertation Committee
Year 3	● Form Dissertation Committee ● Pass Dissertation Proposal DefenseThe dissertation proposal will be presented at the First Dissertation Committee meeting; the student is required to submit an NIH R21-styled research plan proposal Compared to the proposal document presented at the Qualifying Exam in Year 2, which is also related to the student's own research, the Dissertation Proposal should be expanded from the qualifying exam document, and should contain a significantly more refined and tangible research plan that draws a roadmap towards the dissertation. It should also contain preliminary results that demonstrate the feasibility of the proposed project and the progress made so far. Please complete the associated forms and submit those to the department.
Second (and additional) Dissertation Committee meetings	● Meet with the Dissertation Committee regularly, at minimum once per year, to review research and publication progress; please document the date and topics of the meeting discussions for your own record.
At least four months before PhD Dissertation Defense	● Obtain "permission to write" in the Penultimate Dissertation Committee Meeting By the time of the Penultimate Dissertation Committee Meeting, the student should have completed the bulk of the thesis research, and is ready to write the final dissertation (with only a short list of manageable tasks remaining). The student must prepare and submit a "thesis completion proposal" document serving as an initial/early draft of the dissertation, including all completed works. The student

	should specifically include a list of remaining work and the corresponding timeline for completing these tasks before the thesis defense. The document should be sent to the Dissertation Committee at least two weeks before the meeting, and the student should present and answer questions regarding the plan/timeline towards completion. If this presented document and plan is feasible, the committee will approve this thesis completion proposal and give the student "permission to write" for the student's final dissertation. Compared to the student's Dissertation Proposal completed around Year 3, the "thesis completion proposal" should contain significantly more completed research with results and findings to support the productivity and novelty of the project. The thesis committee should evaluate the overall quality and novelty of the research outcomes and decide if the presented completion plan will result in a meaningful dissertation.
At least one month before	• Dissertation Defense Collect signatures and upload final Dissertation to Proquest

3.2.7 PhD Dissertation Defense

All PhD candidates must complete and defend a dissertation of original research in Bioengineering. The dissertation examination committee is composed of the same faculty of the PhD Dissertation Committee, which should have at least one member from outside of the Department. IWe also highly recommended considering adding an External Faculty member from another university or institute.

Please contact BioE Academic Operations Manager **no later than four weeks prior to the Dissertation Defense date** to coordinate room reservation and advertisement of the defense across the University. Please provide the following details:

- Date, start time, finish time
- Expected capacity
- Zoom link if planning a hybrid or virtual presentation
- Title and Abstract, and confirmation of committee members

It is the student's responsibility to schedule a date and time of the final oral examination with all Dissertation Defense Committee members.

Students must send a complete version of their PhD dissertation to their examination committee **no later than two weeks prior to the Defense date.** Although students will have an opportunity to make final revisions to the dissertation and abstract after their Final Oral Examination (Dissertation Defense), the Final Dissertation version should be a complete high-quality document that follows COE formatting guidelines.

The format of the defense will be that of an open presentation to the Northeastern Bioengineering faculty, students and staff, followed by a closed meeting with their dissertation committee in

which candidates are expected to answer all relevant questions regarding their work, its significance and its relationship to ongoing work across the broader research community. The dissertation defense exam is expected to last approximately 2 hours in total.

Important deadlines, instructions, and the PhD Dissertation Signature page can be found on the COE webpage.

Students are required to initiate the submission process after they have successfully defended their PhD Dissertation, **within 24 hours of the defense**. If the examination committee deems that a "conditional pass" is appropriate, the student's advisor must convey the specific conditions and proposed timeline in writing to the Academic Coordinator and Bioengineering PhD Director within 48 hours of the defense. In certain cases, this action may require additional review by the Bioengineering Graduate Development Committee (GDC).

3.3 Example PhD Timeline – Research Milestones

Year 1	Fall	Find Research Advisor Rotations for TA/Fellowship Students (lab rotation form at the start & post-lab rotation at the end) Declare your advisor (advisor declaration form)
	Spring	
	Summer	
Year 2	Fall	Qualifying Exam
	Spring	Makeup Qualifying Exam (or Qualifying Exam for students who started the previous Spring semester)
	Summer	Form PhD Committee
Year 3	Fall	First Committee Meeting, aka. Thesis Proposal; *Dissertation Research Plan in R21 format (PhD Dissertation committee & proposal defense form)*
	Spring	
	Summer	
Year 4	Fall	Second Committee Meeting
	Spring	
	Summer	
Year 5	Fall	Penultimate Committee Meeting: *Permission to write/thesis completion proposal*
	Spring	
	Summer	PhD Dissertation Defense

3.4 PhD Funding

It is the intent and track record of the Department of Bioengineering to ensure continuous funding to all PhD students throughout the tenure of their studies. Most students take about 5 years to complete a PhD degree and may be funded through a variety of mechanisms, including RA and TA awards and external fellowships.

3.4.1 Teaching Assistantships

Teaching Assistantships (TAs) are offered to a mixed cohort of incoming PhD and existing students advised by tenured and tenure-track Bioengineering faculty. TAs are administered by the Department of Bioengineering under the direction of the Business Manager. Students supported by TA are assigned to specific Bioengineering courses to assist instructors in various aspects of teaching, including running laboratories and grading assignments, and therefore require matching of skills with course needs. Students funded by TA on entry are required to perform a laboratory rotation (**Section 3.2.1**) to identify a research advisor and transit to RA funding support after the first two semesters. TA funding requests should be made by a student's research advisor directly to the Business Manager.

3.4.2 Bioengineering Fellowships

Bioengineering Fellowships (BIOE-F) are offered to a highly competitive group of incoming PhD students with outstanding academic achievement to support their stipends for their first two semesters. BIOE Fellowships are managed by the Department of Bioengineering under the direction of the Business Manager. Students funded by BIOE Fellowship on entry are required to perform a laboratory rotation (**Section 3.2.1**) to identify a research advisor and continue their studies with RA funding support in the remaining semesters.

3.4.3 Research Assistantships

Research Assistantships (RAs) are offered directly by research advisors, also referred to as Principal Investigators (PIs), to students with a matching background and research interests using PIs active research grants, to support their dissertation research. RAs are renewable on a semester basis, pending satisfactory research progress and availability of funding. Students should discuss expectations for satisfactory progress with their advisor but can expect a **minimum** of 20 hours per week spent on research.

3.4.4 Receiving Stipend

Please follow the below steps to complete necessary paperwork in order to receive a stipend.

Step 1: If you are an international student and you do not have a Social Security Number, the Graduate School of Engineering will produce an "Engagement Form" for you. This form must be filed to the Office of Global Services (OGS) on campus so that they can process a Social Security Number for you. If you are a newly admitted student, the "Engagement Form" will be provided to the Office of Global Services for your arrival check-in. Otherwise, please request the Engagement Form from the Graduate School of Engineering.

Step 2: All students: please visit the Student Employment Office at 101 Curry Student Center and complete a Direct Deposit Authorization Form and a Form W-4 for tax purposes.

Step 3: All students: Your stipend will be paid directly into your bank account on the 15th and the 30th or 31st of each month during which you hold your assistantship. If your Direct Deposit has not yet been set up, you will collect your paper paycheck at the Human Resources office at 716 Columbus Avenue.

3.4.5 Bioengineering PhD Travel Award

https://bioe.northeastern.edu/coe-research/travel-award-winners/

The Bioengineering Conference Travel Award is a competitive award for BIOE PhD students who have shown outstanding contributions to their lab and the Department by sharing their research through an oral presentation or poster at a conference. Each Bioengineering student is eligible to apply for a $500 travel stipend, up to two times per calendar year, to attend a conference where they are presenting an oral presentation or poster.

3.4.6 Bioengineering PhD Professional Development Support

The Bioengineering Department encourages students to take part in professional development workshops. Each Bioengineering student is eligible to apply for the department to pay for half the cost of the workshop, with the student's PI responsible for the other half. Students must speak with their PI prior to signing up for the workshop or filling out the request form.

4. Statement on Academic and Scholarly Integrity

Throughout one's MS and PhD education, a student will be required to write frequently - this includes assignments, essays, tests, and written exams for your courses, and journal papers, texts, conference abstracts and papers related to your research. Please note that plagiarism is considered a form of severe academic/scholarly misconduct and is strictly prohibited at Northeastern and the Department. This means that under absolutely no circumstance a student is it permitted to present another student's or scholar's work without appropriate citation or attribution of credits. Verbatim copies of text, including text with minor modifications, without citing the source are considered unacceptable for any academic or scholarly works at Northeastern, if detected, can result in severe penalties including failure of courses or exams, loss of funding, or discharge from the degree program.

The prohibition of plagiarism also applies to computer codes. For all copyrighted computer programs and codes, one must carefully read and understand the respective software licenses declared by the upstream authors or copyright owners in order to determine whether it is appropriate to be used in your coursework or research. All included software codes, including those with open-source licenses, must be appropriately acknowledged according to the upstream license requirements in your reports or publications (including papers or software releases). In the end you are responsible for any work you hand in and may be asked to explain it to the instructor, so do not hand in anything you do not understand! In the case of improper collaboration, penalties may be assessed to all students involved. Please note that copying code snippets posted on forums or websites (such as StackOverflow) is highly problematic and shall not be used beyond the scope of "fair use" defined by copyright laws.

Similarly, plagiarism from journals, texts or websites are also considered unacceptable; they will be dealt with under the discretion of the course instructor and the Graduate Director. Also please note that assignments and written exams may be tested by the instructor or examination committees using plagiarism detection apps such as Turnitin.

If one has any doubt in a specific situation about what level of collaboration is acceptable, one should ask your instructor or advisor!

5. Petition and Registration Override Procedures

Please note the following:

1. Petitions/overrides for taking courses must be filed and approved **before** registration in the course.
2. Filing a petition/override does not mean that it will be approved, you need to receive the approval to go ahead.
3. Please file your petitions/overrides well in advance. Processing a petition/override takes at least 7 business days.
4. When submitting your petition/override make sure it is completed and signed by you. If you have a research advisor, the form must be signed by him/her as well. If the signature of the instructor is needed (for override forms), please make sure that you obtain the signature.
5. All petitions/overrides must be submitted with a copy of your current transcripts. Unofficial transcripts are acceptable for this purpose.

Here are the steps for filing petitions/overrides:

1. To file a petition:
   (a) Complete the petition form from here.
   (b) Complete the form; this will then automatically be sent to the appropriate contacts for their approval

2. To file a registration override form (these forms are used to register in courses that have restrictions:
   (a) Completed the override form from here; this will then automatically be sent to the appropriate contacts for their approval

5.1 Online (V35) Class Sections - Policies and Procedures

V35 Online Asynchronous Courses:

Enrolling in asynchronous courses can only be approved for graduate students who meet the below requirements. A registration override form is required to enroll.

You must fit one of the following categories:

- you are a **part-time student**
- you are an **Industrial PhD student**
- you are a **full time student with have you have a true conflict of time,** with your Northeastern-related research and the time that the course is scheduled to be taught in person, and approval has been given by your lab advisor/PI before submitting the override
- If you are an **international student**, you must adhere to the guidelines on online courses to maintain visa status. Please review these requirements ahead of submitting an override form.

6. Academic Probation Policies and Procedures

To maintain good academic standing, students must maintain an overall 3.0 GPA and attain a C grade or higher in all of their core courses. So, if a student attains a "C–" (C-minus) grade or below in a core course but has a 3.0 overall, they will need to retake that class to meet the graduating requirements.

If a student's GPA falls below 3.0, they will be placed on an academic probation. Please refer to Sections 3.2.2 and 3.2.3 for information on performance probations.

One academic term with cumulative GPA below 3.000: Students with a cumulative GPA below 3.000 for one term are required to complete an Academic Probation Action Plan to be signed and approved by their academic advisor and submitted to the Graduate School within 7 business days from the start of the next academic term.
Two consecutive terms with cumulative GPA below 3.000: Students with a cumulative GPA below 3.000 for two consecutive terms will be dismissed from their degree program at the end of the second term. Students in this situation may submit an Academic Dismissal Appeal Form to the Graduate School to request a final one-term extension. The appeal will be reviewed by the student's department.
Three consecutive terms with cumulative GPA below 3.000: Students with a cumulative GPA below 3.000 for three consecutive terms will automatically be dismissed from their degree program. In this case, the student may submit an appeal to the Associate Dean of the Graduate School per the University appeals process.

For more information, please refer to the College of Engineering website

7. Policies and Procedures for Course Transfer

Graduate students can transfer a maximum of 9 SH (or equivalent) course work from other institutions. Advanced Entry students may transfer a maximum of 4 SH. 4 SH of course work is defined as 45 hours of lectures. For credit transfer from other institutions, the following conditions must be satisfied:

1. Students should have a grade of at least B (or equivalent) in the course.
2. The course must be passed during the past seven years.
3. The course should not be part of the requirements of a degree received by the student in the past.

4. The course will be reviewed by the Graduate Development Committee and should be approved as equivalent to a graduate-level Northeastern course that students can take as part of their degree program.

The process for transfer credit requires filing a Petition to Transfer Credit form. The petition should be accompanied by the detailed syllabus of the course (including textbook information) and the equivalent NU course as well as sufficient evidence that the course has not been part of the requirements of a degree received by the student. Evidence should be noted on the transcripts *or* be sent in a letter/formal email from the Student Service Coordinator (or equivalent) confirming credits were not used towards a degree in the former institution.
The full policy for transferring credits can be found here.

If you are a Northeastern MS BIOE student transferring to the PhD Bioengineering program before the end of the MS program, the relevant graduate BIOE courses you have taken may transfer without limit.

8. Policies and Procedures for Requesting Changes in the Graduate Program

In general, changes to the graduate program are possible after completing at least one semester at Northeastern. This gives the students an opportunity to get accurate information about each program in order to make an informed decision. The only request for change in the program that is accepted during the first semester is change from full-time (FT) to part-time (PT) or from part-time to full-time. This change does not apply to those who hold an F-1 student visa.

1. **Change from FT to PT or PT to FT.** This is the only change that can be petitioned during the first semester. To request this change you need to file a petition as explained in **Section 4**. FT PhD students cannot change to PT before having a research advisor. Change from FT to PT for international students is only possible if it complies with the immigration regulations; please verify with the Office of Global Services.
   For International Students: An approved change of program requires that a new I-20 be issued. It is the student's responsibility to initiate the I-20 process. Instructions are provided on the official admission acceptance letter. Questions should be directed to the International Student and Scholar Institute on campus.
2. **Change from PhD to MS, or MS to PhD:** Students need to file a Change in Degree Level form.

9. Co-op & Experiential Learning

Co-op and internship are forms of CPT (Curricular Practical Training) that allow full-time students to integrate a practical learning experience into their graduate program. With full approval and ongoing discussion with their PI, internship is an option for PhD students only to provide them with work experience that is integral to the student's education, i.e., required for their dissertation research. Internship provides the opportunity to further the students' training and knowledge in an area central to the advancement of their research. It does not refer to an "internship" as used by companies, agencies and other institutions. Examples include students working at a company, government lab or other entity whereby the tasks, data, protocols, etc. will

be brought back to NU and used in an integral way in the advisor's lab and the student's research. Coop is available to all graduate students and its goal is to provide students with actual work experience in their field of study and need not be research oriented (though it often is).

Professional courtesy should be used when deciding whether to pursue a co-op or internship, and you should coordinate all aspects with your PI to ensure your PhD research and milestones are prioritized. The PI should also be involved in all stages of co-op planning. Your PI will need to approve the timeline with you and the co-op team prior to moving forward with the process. If no effort is made to coordinate with your PI ahead of time, funding may not be able to be guaranteed following your co-op or internship.

9.1 Eligibility

To start the co-op search process, College of Engineering graduate students must:

1. Be enrolled full-time at Northeastern University.
2. Meet all English-language requirements described in the table below.
3. Meet the minimum GPA for their program.
4. Have no disciplinary or standing academic probation issues and no incomplete courses (i.e., no I grade in their records).
5. Have at least one term left in their program after completing co-op (i.e., students must return to Northeastern to take courses (including Dissertation Series), for at least one term prior to graduating).
6. Have a valid I-20 (for international students).
7. Have completed their first full time semester with a minimum of 8SH completed.
8. Be enrolled in or have completed the Career Management for Engineers (ENCP 6000) or Introduction to Cooperative Education (ENCP 6100) course (depending on their major).
9. Complete a COE Co-op Application and receive Co-op Coordinator approval to initiate a co-op job search.

To participate in Co-op, College of Engineering graduate students must:

1. Meet the minimum semester-hour requirements of 16SH completed as described in the table below.
2. Successfully complete the Career Management for Engineers (ENCP 6000) or Introduction to Cooperative Education (ENCP 6100) (depending on their major).
3. Receive Co-op Coordinator approval prior to accepting a co-op job offer.
4. Meet all the additional requirements as listed above for starting the co-op search process.

9.2 Applying for Co-op

For full details and instructions on the co-op process, please visit the Graduate Co-op Page, or contact Senior Co-op Coordinator Max Sederer at m.sederer@northeastern.edu

10. Vacation Policy

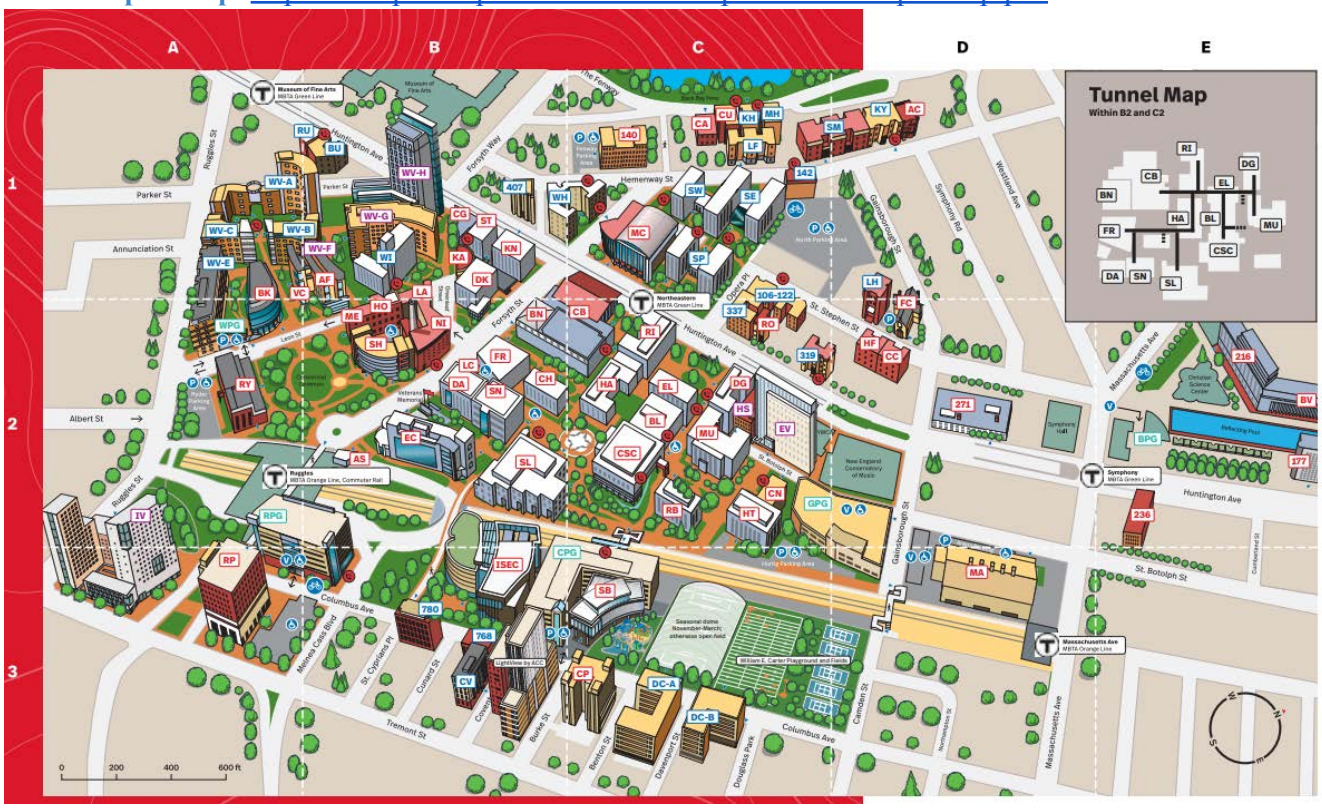
All full-time Bioengineering PhD students are entitled and encouraged to take two weeks (10 working days) of vacation a year. This vacation time is in addition to the standard Northeastern University holidays, (see Registrar's webpage). Please note that vacation time may not be rolled over to subsequent years.

PhD students should coordinate with their PI/research advisor (and Course Instructor for TAs) in a timely way about their requested vacation time. Time off must be discussed and approved before time off is taken, and the time should not interfere with teaching or research obligations. In the event a student is required to complete research or be present in the lab due to live experiments during Northeastern University holidays, the student and their research advisor should arrange alternate time off.

To ensure funding is unaffected, extended periods of time away from campus, including extended delays with international travel, should be approved by the student's PI/research advisor and the Department of Bioengineering Associate Chair for Research and PhD Programs. In some cases, additional approval may be needed from the Graduate School of Engineering.

Please refer to the University's Attendance Policies for details on Leaves of Absence and other absences. Please reach out to the Department of Bioengineering Associate Chair for Research and PhD Programs with any concerns or questions regarding time off.

11. Campus Map https://campusmap.northeastern.edu/printable/campusmap.pdf



Academic and Service Buildings

C1 140 The Fenway (140)
E2 177 Huntington (177)
E2 216 Massachusetts Ave (216)
E2 236 Huntington (236)
D2 271 Huntington (271)
B1 O'Bryant African American Institute (AF)
C3 Alumni Center (CP)
B2 Architecture Studio (AS)
D1 Asian American Center (AC)
B2 Barletta Natatorium (BN)
A1 Behrakis Health Sciences Center (BK)
E2 Belvidere Place (BV)
C2 Blackman Auditorium (BL)
C2 Cabot Physical Education Center (CB)
C1 Cahners Hall (CA)
B1 Cargill Hall (CG)
D2 Catholic Center (CC)
B2 Churchill Hall (CH)
C3 Columbus Place (CP)
C2 Cullinane Hall (CN)
C2 Curry Student Center (CSC)
C1 Cushing Hall (CU)
B2 Dana Research Center (DA)
B1 Dockser Hall (DK)
C2 Dodge Hall (DG)
C2 East Village (EV)
B2 Egan Research Center (EC)
C2 Ell Hall (EL)
D2 Fenway Center (FC)
B2 Forsyth Building (FR)
C2 Hastings Hall (HS)
C2 Hayden Hall (HA)
D2 Hillel-Frager (HF)
B2 Holmes Hall (HO)
C2 Hurtig Hall (HT)
B3 Interdisciplinary Science and Engineering Complex (ISEC)
A2 International Village (IV)
B1 Kariotis Hall (KA)
B1 Knowles Center (KN)
B1 Lake Hall (LA)
B2 Latinx Student Cultural Center (LC)
C1 Marino Recreation Center (MC)
D3 Matthews Arena (MA)
B2 Meserve Hall (ME)
C2 Mugar Life Sciences Building (MU)
B2 Nightingale Hall (NI)
A3 Renaissance Park (RP)
C2 Richards Hall (RI)
C2 Robinson Hall (RB)
C2 ROTC Office (RO)
A2 Ryder Hall (RY)
B2 Shillman Hall (SH)
B2 Snell Engineering Center (SN)
B2 Snell Library (SL)
C3 Badger & Rosen SquashBusters (SB)
B1 Stearns Center (ST)
A1 Visitor Center (VC)
B1 West Village F, G, H (WV)

Residence Buildings

B3 10 Coventry (CV)
C1 106–122 Levine (106-122)
C1 142–148 Hemenway St (142)
C1 153 Hemenway St (LF)
C2 319 Huntington Ave (319)
C2 337 Huntington Ave (337)
B1 407 Huntington Ave (407)
B3 768 Columbus Ave (768)
B3 780 Columbus Ave (780)
B1 Burstein Hall (BU)
C3 Davenport Commons A, B (DC)
C2 East Village (EV)
C2 Hastings Hall (HS)
A2 International Village (IV)
D1 Kennedy Hall (KY)
C1 Kerr Hall (KH)
D1 Light Hall (LH)
C1 Loftman Hall (LF)
C1 Melvin Hall (MH)
B1 Rubenstein Hall (RU)
D1 Smith Hall (SM)
C1 Speare Hall (SP)
C1 Stetson East (SE)
C1 Stetson West (SW)
A1 West Village A, B, C, E (WV)
B1 West Village F, G, H (WV)
B1 White Hall (WH)
B1 Willis Hall (WI)

Parking Garages

C3 Columbus Parking Garage (CPG)
E2 Belvidere Parking Garage (BPG)
C2 Gainsborough Parking Garage (GPG)
A2 Renaissance Park Parking Garage (RPG)
A2 West Village Parking Garage (WPG)

Key Bioengineering Buildings

The Interdisciplinary Science & Engineering Complex (ISEC)

Many of the labs and most of our Bioengineering faculty have offices on the second and third floors. The Bioengineering department administrative offices are in 206 ISEC.

Snell Engineering Center

The College of Engineering Graduate Student Services Office is located at 130 Snell.

Mugar Life Sciences Building

Several Bioengineering labs are in Mugar.

Egan Research center

Raytheon Amphitheater is a popular spot for events. The building houses many other events and seminar rooms.

Curry Student Center

Shop in the Northeastern bookstore for textbooks and school supplies, and clothing adorned with the Northeastern logo. There is also the largest food court on campus and a Starbucks.

Labs: Faculty members have lab spaces in the following areas:

Prof. Amini	456 Snell
Prof. Asthagiri	260-272 ISEC
Prof. Bajpayee	260B, 262C ISEC
Prof. Bellini	260-272 ISEC
Prof. Chung	020 ISEC
Prof. Dai	260-272 ISEC
Prof. Ebong	275 ISEC
Prof. Fang	020 ISEC
Prof. Jain	367B, 367C, 368B ISEC
Prof. E. Levine	Mugar 415
Prof. H. Levine	177 Huntington Ave.
Prof. Libby	260-272 ISEC
Prof. Loth	Forsyth Building
Prof. Lu	1319 177 Hungtington
Prof. Makowski	260-272 ISEC
Prof. Minkara	306 ISEC
Prof. Niedre	020 ISEC
Prof. Oakes	260-272 ISEC
Prof. Parameswaran	260-272 ISEC
Prof. Rouhanifard	378 ISEC
Prof. Ruberti	260-272 ISEC
Prof. Shefelbine	260-272 ISEC
Prof. Slavov	Mugar 111 & 119
Prof. Sontag	355 ISEC
Prof. Sun	364B, 365B, 366C ISEC
Prof. Yaseen	045 ISEC

Popular Coffee Spots

Dunkin Donuts - Hayden Hall, Shillman Hall
Starbucks Coffee – Curry Student Center
Pavement Coffeehouse - 44 Gainsborough St
Render Coffee - 563 Columbus Ave
Thinking Cup - 165 Tremont
Tatte Bakery and Café - 369 Huntington Ave
Oakleaf Cakes Bake Shop - 12 Westland Ave
Caffe Nero - 114 New Edgerly Rd

12. Other Useful links

- **Graduate School of Engineering - all policies and procedures**
- **Academic Integrity**
- **Code of Student Conduct**
- **BioE Department Website**
- **BioE Facebook**
- **BioE Twitter**
- **BioE Instagram**
- **BioE LinkedIn**
- **Graduate School of Engineering**
- **Graduate Student Services** and **Graduate Student Resources**
- **Official University Calendars**
- **Registrar's Office**
- **University Health and Counseling Services**
- **General Graduate Forms**
- **NU Graduate Catalog**
- **NU Health and Wellness On-Campus Resources**

13. Bioengineering Faculty and Staff

Rouzbeh Amini (he/him)
Associate Professor, Mechanical and Industrial Engineering
Jointly appointed in Bioengineering
Biomechanics, mechanobiology, and biotransport with applications in the eye, heart, and brain.
508 ISEC, r.amini@northeastern.edu

Anand Asthagiri (he/him)
Associate Professor, Bioengineering
Cell engineering, cancer cell biology. The Asthagiri lab investigates how cancer cells migrate and invade their surroundings during metastasis. We apply quantitative experimental analysis of live-cell imaging and mathematical modeling to gain an understanding of single-cell behaviors and cell-cell interactions during cancer progression.
226 ISEC, a.asthagiri@northeastern.edu
Lab website: www.cell-engineering.org

Ambika Bajpayee (she/her)
Associate Professor, Bioengineering
Targeted drug delivery to connective and charged tissues. Her lab utilizes concepts of nanomedicine and bio-electrostatics to design polypeptides and protein-based carriers for targeted and sustained delivery of small molecule drugs, protein growth factors, antibodies and genetic materials to specific intra-tissue and intra-cellular target sites inside connective tissues.
216 ISEC, a.bajpayee@northeastern.edu

Chiara Bellini (she/her)
Associate Professor and Associate Chair for Research and PhD Programs, Bioengineering
Diseases of the cardiovascular system; effects of cell mediated growth and remodeling processes on tissue and organ mechanics
228 ISEC, c.bellini@northeastern.edu

Samuel Chung (he/him)
Assistant Professor, Bioengineering
Researches central nervous system regeneration model in C. elegans, femtosecond laser surgery; user-friendly and low-cost fluorescence microscopy.
218 ISEC, s.chung@northeastern.edu
Lab website: https://sites.google.com/view/wormneurolab/

Guohao Dai (he/him)
Professor, Bioengineering
Researches 3-D bioprinting technology, stem cells technology and vascular bioengineering.
224 ISEC, g.dai@northeastern.edu

Eno Ebong (she/her)
Associate Professor, Chemical Engineering.
Jointly appointed in Bioengineering
Researches the means by which endothelial cell mechanotransduction occurs in order to prevent or promote diseases related to blood vessel dysfunction.
221 ISEC, e.ebong@northeastern.edu
Lab website: Ebong Laboratory

Qianqian Fang (he/him)
Associate Professor, Bioengineering
Researches innovations in translational medical imaging devices to better diagnose cancers, neuroinformatics, and high-performance computing tools to facilitate the development of the next-generation imaging methods.
223 ISEC, q.fang@northeastern.edu
Lab websites: http://fanglab.org, http://mcx.space, https://neurojson.org
Twitter: @FangQ

Daniel Grindle (he/him)
Assistant Teaching Professor, Bioengineering

Ben Gyori (he/him)
Associate Professor, Khoury College of Computer Sciences
Jointly appointed in Bioengineering

Christa Haase (she/her)
Assistant Professor, Bioengineering
Jointly appointed in Physics

Aileen Huang-Saad (she/her)
Associate Professor, Bioengineering
Director of Life Science and Engineering Programs, Roux Institute
Entrepreneurship education microenvironments and their impact on the engagement of diverse populations, the influence of I-Corps on university ecosystems, and transforming BME education through instructional design.
Roux Institute, Portland ME, a.huang-saad@northeastern.edu
Lab Website

Michael Jaeggli (he/him)
Associate Teaching Professor and Associate Chair for Master's Education and Global Operation, Bioengineering
Focuses on curricular development and program delivery in bioengineering. During graduate school he specialized in heart valve tissue engineering and the use of 3D printing technologies for surgical planning. He is currently partnering with the Roux Institute to research and develop interdisciplinary programs to address rural health disparities in Maine.
342 Snell Engineering, m.jaeggli@northeastern.edu

Miten Jain (he/him)
Assistant Professor, Bioengineering
Jointly appointed in Physics
Research Focus: Nanopore technology, single-cell techniques, computational biology
research Projects:Characterization of paired tumor and normal cell lines using long read sequencing;Multi-platform, high-coverage, long read sequencing of reference human genomes.
206D ISEC, mi.jain@northeastern.edu

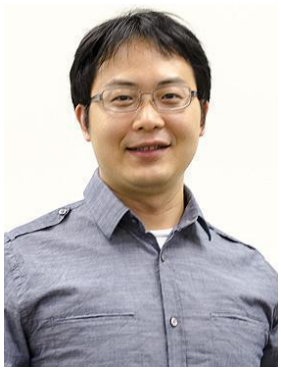
Timothy Lannin (he/him)
Associate Teaching Professor and Associate Chair for Undergraduate Affairs, Bioengineering
Previous research includes work on automating image analysis of cancer cells, measuring the electrical properties of cancer cells to use electric fields to separate them from blood cells, and measuring the electrical properties of algae cells to optimize their output for biofuels.
342 Snell Engineering, t.lannin@northeastern.edu

Erel Levine (he/him)
Associate Professor, Bioengineering
Researches the analysis of big biological data by developing statistical physics approaches to deep learning; statistical learning approaches to the dynamics, plasticity and evolvability of small regulatory RNA; host-pathogen interaction: in-host dynamics and inter-species systems biology.
328 ISEC, e.levine@northeastern.edu
Lab website: https://web.northeastern.edu/sysbioeng/

Herbert Levine (he/him)
University Distinguished Professor, Physics
Jointly appointed in Bioengineering
Studies mechanics of motility at both single cell and multicellular levels, genetic and metabolic networks underlying phenotypic changes en route to cancer metastasis, effective detection by and activation of the adaptive immune system. See my entry at ctbp.northeastern.edu for more info.
1308, 177 Huntington Ave; h.levine@northeastern.edu

Elizabeth Libby (she/her)
Assistant Professor, Bioengineering
Researches synthetic biology to build predictably performing biological systems for applications such as biosensor development and quantitative microbiology.
323 ISEC, e.libby@northeastern.edu
Lab website: https://libbylab.sites.northeastern.edu/

Francis Loth (he/him)
Professor, Mechanical and Industrial Engineering
Jointly appointed in Bioengineering
Researches biological flows, experimental fluid mechanics, computational fluid mechanics, blood flow simulation, cerebrospinal fluid simulation, Chiari malformation, syringomyelia, medical image processing, magnetic resonance imaging
257 Snell Engineering, f.loth@northeastern.edu



Mingyang Lu (he/him)
Assistant Professor, Bioengineering
Uses systems biology approaches to uncover the underlying principles governing the operation of genetic networks. Integrates computational modeling and data analysis to elucidate the relationship among robustness of network dynamics, stochasticity in gene expression and heterogeneity in cancer evolution.
1319, 177 Huntington, m.lu@northeastern.edu
Lab websites: lusystemsbio.northeastern.edu;geneex.jax.org

Lee Makowski (he/him)
Professor and Chair, Bioengineering
Jointly appointed in Chemistry and Chemical Biology.
Research focus is on the molecular basis of Alzheimer's disease and other neurodegenerative disorders and the linkage between the structure of pathological fibrillar aggregates and disease progression. The work involves collaboration with neuropathologists in the use of scanning x-ray microdiffraction for study of fibrillar structures within human brain tissue.
206B ISEC, l.makowski@northeastern.edu

Mona Minkara (she/her)
Assistant Professor, Bioengineering
Using computational methods, such as Monte Carlo and molecular dynamics simulations, to obtain a fundamental understanding of molecular interactions that occur at biological interfaces, such as the pulmonary surfactant system
325 ISEC, m.minkara@northeastern.edu
Lab website: https://www.monaminkara.com

Mark Niedre (he/him)
Professor, Bioengineering
Associate Dean for PhD Education, College of Engineering.
Researches and finds interest in biomedical optics and non-invasive imaging, rare cell detection and tracking in the body, image reconstruction and biomedical signal processing.
Office 217 ISEC, Lab 020 ISEC
m.niedre@northeastern.edu
Lab website: https://sites.google.com/site/niedrelab/home

Stephanie Noble (she/her)
Assistant Professor, Psychology
Jointly appointed in Bioengineering
Statistical and computational tools to facilitate more precise human neuroscience inference and prediction

Jessica Oakes (she/her)
Associate Professor, Bioengineering
Researches pulmonary physiology, biofluids and transport phenomenon, computational biomechanics, magnetic resonance imaging, and multi-scale modeling. She is interested in applications pertaining to wildland fire smoke inhalation, e-cigs, and asthma.
229 ISEC, j.oakes@northeastern.edu
Lab website: https://www.northeastern.edu/biofluids/

Harikrishnan Parameswaran (he/him)
Associate Professor, Bioengineering
Researches the mechanobiology of smooth muscle contractions to understand the fundamental mechanisms regulating airway caliber and why they fail in diseases like asthma.
219 ISEC, h.parameswaran@northeastern.edu
Lab website: https://web.northeastern.edu/breathe/

Sara Rouhanifard (she/her)
Assistant Professor, Bioengineering
Developing chemical approaches to track and quantify RNA modifications in cells; understanding differences in RNA expression and the impacts on disease and development. Single-molecule fluorescent imaging of RNA. Nucleic acid technologies.
220 ISEC, s.rouhanifard@northeastern.edu
Lab website: https://rouhanifardlab.com/
Twitter: @SRouhanifard

Jeffrey W. Ruberti (he/him)
Professor, Bioengineering
Researches tissue engineering of load-bearing matrix (bone, cornea), bioreactor design, multi-scale mechanobiochemistry, statistical mechanics, energetics microscopy, high-resolution imaging; and biopolymer self-assembly.
215 ISEC, j.ruberti@northeastern.edu

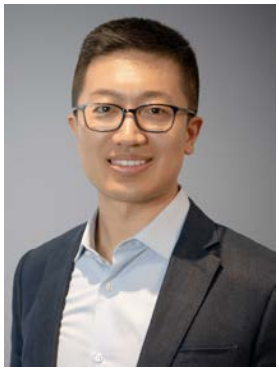
Sandra Shefelbine (she/her)
Professor, Mechanical and Industrial Engineering
Associate Dean for Space and Special Initiatives, Office of the Dean
Jointly appointed with Bioengineering
Researches multi-scale bone biomechanics – how the structure and composition of bone influences its mechanical properties; mechano-adaptation of bone and joint – how tissue responds to mechanical signals.
222 ISEC, s.shefelbine@northeastern.edu
Lab website: www.shefelbine.org

Shiaoming Shi (he/him)
Associate Teaching Professor, Bioengineering
Researches cancer detection and drug discovery technologies.
342 Snell Engineering, s.shi@northeastern.edu

Nikolai Slavov (he/him)
Associate Professor, Bioengineering, Allen Distinguished Investigator
Researches single-cell proteomics, Ribosome-mediated translational regulation, and quantitative systems biology. Most recently Slavov lab developed a high-throughput method for single cell proteomics by mass spectrometry and used it to quantify proteome heterogeneity during cell differentiation.
334 MU, n.slavov@northeastern.edu

Eduardo Sontag (he/him)
University Distinguished Professor, Electrical and Computer Engineering
Jointly appointed in Bioengineering
Researches feedback control theory, systems biology, cancer, and biomedicine.
326 ISEC, e.sontag@northeastern.edu

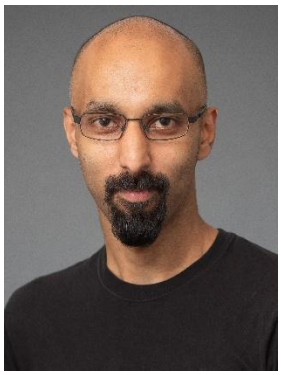
Esin Sozer (she/her)
Assistant Teaching Professor, Bioengineering
342 Snell Engineering
Research training spanned electrical engineering, plasma physics, accelerator physics, and biophysics. Research interests include biophysics of electric field and biological system interactions, electropermeabilization, and electrostimulation.



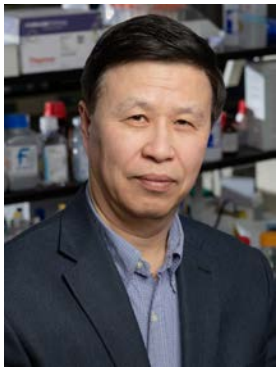
Tao Sun (he/him)
Assistant Professor, Bioengineering
Research Focus: Focused Ultrasound, Ultrasound Imaging, Neuroimaging, Drug Delivery, Immunomodulation and Immunoengineering, Gliomblastoma, Alzheimer's Disease
Works at the intersection of focused ultrasound, neuroimaging and immunoengineering; developing ultrasound devices, imaging methods and engineered cell systems to modulate the neuro-immune interface and their applications in immunomodulation, drug delivery, and cell-based theranostic systems.
206C ISEC, t.sun@northeastern.edu

Amir Vhabikashi (he/him)
Assistant Professor, Bioengineering

Raimond Winslow (he/him)
Professor, Bioengineering
Jointly appointed in Khoury College of Computer Sciences, and Clinical & Rehabilitation Services.
Director of Life Science and Medicine Research, Roux Institute
Computational modeling of the cardiac myocyte to understand the molecular basis of arrhythmias; machine learning in critical care medicine to identify those patients who require urgent care
Roux Institute, Portland ME, r.winslow@northeastern.edu



Mohammad Abbas Yaseen (he/him)
Assistant Professor, Bioengineering
Research Focus: Advanced microscopy for minimally invasive, in vivo characterization of brain function
Research Projects: Relating neuroimmune and neurovascular alterations during Alzheimer's Disease progression Principal Investigator, National Institute of Health
Near Infrared Fluorescence Imaging of Reactive Oxygen Species in Alzheimer's Disease Co-Investigator, National Institute of Health
318 ISEC, m.yaseen@northeastern.edu
Lab website: https://www.yaseen-omnilab.org/



Ning Wang (he/him)
Professor, Bioengineering
Director of Mechanobiology Institute, Northeastern University
Cellular and molecular mechanomedicine, Cancer cell biology and mechanics, Embryonic stem cell biology and mechanics, Mechanical biotechnologies and their applications to cells, tissues, and organisms, Mechanotransduction: nuclear deformation and gene expression.

Lei Wang (she/her)
Assistant Professor, Bioengineering
Jointly appointed in Biology

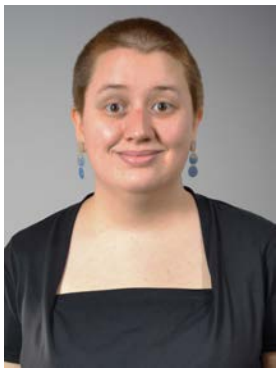
Jing Ke Weng (he/him)
Professor, Chemistry and Chemical Biology
Jointly appointed in Bioengineering

STAFF

Esther Cohen (she/her)
Senior Business Manager
e.cohen@northeastern.edu
206C ISEC

Sofia Baah (she/her)
Marketing, Events, and Communications Coordinator
s.baah@northeastern.edu
206 ISEC

Noah Joseph (he/him)
Senior Engineering Lab Technician
n.joseph@northeastern.edu
057 Richards Hall



Kathryn Lasseter (they/them)
Lab Operations & Safety Manager
k.lasseter@northeastern.edu
234 ISEC

Saige McGinnis (she/her)
Lab Technician
s.mcginnis@northeastern.edu
234 ISEC

Caroline Pridmore (she/her)
Academic Operations Manager
c.pridmore@northeastern.edu
206 ISEC

Prachi Shah (she/her)
Financial Operations Coordinator
pr.shah@northeastern.edu
206 ISEC

Appendix A. Bioengineering Department Safety Training

All PhD students and MS students who plan to perform laboratory research are required to complete the basic Department of Bioengineering laboratory safety program, plus any additional lab-specific safety training as detailed below. Students are strongly advised to complete this training in the first month following matriculation. For more information please contact the Lab Operations and Safety Manager **Kathryn Lasseter (k.lasseter@northeastern.edu)**.

How to join BioE Lab (Updated Fall 2023)

Please carefully read and complete all instructions below to join a lab in the Department of Bioengineering. You may send questions to Kathryn Lasseter (k.lasseter@northeastern.edu).

Step 1: NEU account

Verify that you have an active status with Northeastern University (e.g. student, staff, faculty, volunteer, visiting scholar). For volunteers, visiting scholars, and visiting researchers, please note that obtaining a Sponsored Account may not be sufficient for lab access. If you are not sure if you have an active status with Northeastern University, contact the Department of Bioengineering Business Manager, Esther Cohen (e.cohen@northeastern.edu).

Step 2: Confer with PI

Contact the faculty member/PI of the lab you wish to join. Once you have reached an agreement to join the lab, move to the next step.

Step 3: Register for BioRAFT

Self‑register for the lab in BioRAFT.

A. Navigate to https://northeastern.bioraft.com/ and log in with your Northeastern username and password.
B. Click "My Account" on the left hand-banner, then click “My Profile.”
C. Click “Self‑register for a Lab” and follow the instructions (do not check or uncheck any of the checkboxes)

Step 4: Complete BioRAFT trainings

Register for and complete the BioRAFT‑hosted safety training requirements for the lab. Note that classroom courses are conducted by OARS staff over Microsoft Teams at set times which you have to register for via BioRAFT.

Review the training requirements by going to this list of student resources and selecting the document titled “Safety Training Requirements … Groups.”

To access online trainings:

A. Navigate to BioRAFT and log in.
B. Click on “Training” on the left hand banner then select “Course Directory.”
C. Click on “Launch Course” for each online course you must complete.

D. Click on "Sign Up" for each classroom course you must complete and select a date/time that works for you.

Important: When you log into BioRaft, the main page will show you a table of required training. *This table may not be comprehensive*. The only way to know if you have completed all the required training for your lab is to compare the Bioengineering Safety Training Requirements document to your full training history in BioRaft.

Step 4.5: Autoclave training

If you need autoclave access, complete the Autoclave I training on BioRAFT. Then, ask an experienced user to demonstrate how to use your building autoclave. Email Kathryn (k.lasseter@northeastern.edu) and cc the person who trained you to request card access.

Step 5: Get Card Access

Once you've completed the required trainings, email Kathryn (k.lasseter@northeastern.edu) with your NUID and PI name. Once they check your BioRAFT trainings, they will update your card with the lab and write-up area access.

Step 6: Pay attention to expiration dates!

BioRAFT: Some trainings will require regular recertification. Please keep an eye out on those expiration dates. Reach out 7-10 days before your card access expires to extend access to lab spaces. If you are graduating, please reach out at least 14 days before that expiration date.

Enrollment: Your card access will expire if the semester ends and you are not enrolled for the next. The Husky card office will list you as a "former student" and your card access for lab, office, and campus spaces will end. While this is fixable, it's much simpler to double check your enrollment status as the semester ends.

Step 7: Going forward

To request access to additional lab spaces, repeat Steps 4 through 7.

Appendix B. Suggested PhD Electives by Research Area and Master Electives List

please file a petition form for any courses not currently listed on the catalog

Area 1 – Biomedical Devices and Bioimaging

BIOE 5235	Biomedical Imaging
BIOE 5648	Biomedical Optics
BIOE 5800	Systems, Signals, and Controls for Bioengineers
BIOE 5810	Design of Biomedical Instrumentation
EECE 5606	Micro- and Nanofabrication
EECE 5642	Data Visualization
EECE 7200	Linear Systems Analysis
EECE 7202	Electromagnetic Theory 1
EECE 7203	Complex Variable Theory and Differential Equations
EECE 7204	Applied Probability and Stochastic Processes
EECE 7211	Nonlinear Control
EECE 7271	Computational Methods in Electromagnetics

Area 2 - Biomechanics, Biotransport and MechanoBiology

BIOE 5650	Multiscale Biomechanics
BIOE 5820	Biomaterials
BIOL 5601	Multidisciplinary Approaches to Motor Control
IE 7315	Human Factors
ME 5650	Advanced Mechanics of Material
ME 5655	Dynamics and Mechanical Vibration
ME 5657	Finite Element Method
ME 5658	Continuum Mechanics
ME 5659	Control Systems Engineering
ME 5665	Musculoskeletal Biomechanics
ME 5654	Elasticity and Plasticity
ME 7238	Advanced Finite Element Method
PT 5138	Neuroscience
+ PT 5139	Lab
PT 5150	Motor Control, Development and Learning
+ PT 5151	Lab

Area 3 – Molecular, Cell, and Tissue Engineering

BIOE 5410	Molecular Bioengineering
BIOE 5430	Principles and Applications of Tissue Engineering
BIOL 5543	Stem Cells and Regeneration
BIOE 5650	Multiscale Biomechanics
BIOE 5820	Biomaterials
BIOL 6401	Research Methods and Critical Analysis in Molecular Cell Biology
CHEM 5612	Principles of Mass Spectrometry
CHME 5630	Biochemical Engineering
PMST 6254	Advanced Drug Delivery System

Area 4 – Systems, Synthetic, and Computational Bioengineering

Restricted
Electives

BIOE 5115	Dynamical Systems in Biological Engineering
BIOE 5710	Experimental Systems and Synthetic Bioengineering
BIOE 5720	Physical Bioengineering
BIOE 5750	Modeling and Inference in Bioengineering

Elective List

BINF 6400	Genomics in Bioinformatics
BINF 6410	Proteomics in Bioinformatics
BIOE 5440	The Cell as a Machine
BIOE 5510	Bioengineering Products/Technology Commercialization
BIOE 5640	Computational Biomechanics
BIOE 5760	Method and Logic in Systems Biology and Bioengineering
BIOE 5860	Engineering Approaches to Precision Medicine I
BIOE 5870	Engineering Approaches to Precision Medicine II
BIOE 5880	Computational Methods in Systems Bioengineering
BIOL 6299	Molecular Cell Biology for Biotechnology
CHEM 5638	Molecular Modeling
CHME 5630	Biochemical Engineering
DS 5220	Supervised Machine Learning and Learning Theory
DS 5230	Unsupervised Machine Learning and Learning Theory
PHSC 6290	Biophysical Methods in Drug Discovery
PHYS 5116	Network Science

All areas: Master List of Approved BioE PhD Electives can be found on the Course Catalog - No petition form required for any courses listed

Appendix C. Laboratory Rotation Form and Post-Lab Evaluation Form

Graduate Student Lab Rotation Allocation Form (Prior to Rotation)

Rotation mentors must be a Core Faculty or Affiliated Faculty of the Bioengineering Department. The rotation is an opportunity to determine if the lab is a good 'fit' for both mentor and the student. Students are expected to do 2 rotations and should choose a mentor and program by the beginning of Spring Term.

- **ROTATION ADVISOR**

Name:
Primary Admin Dept.: _____
Phone: _____ **Email:** _____
Research area affiliation (mark all that apply)

- ☐ Biomedical Devices & Bioimaging
- ☐ Biomechanics, Biotransport, & Mechanobiology
- ☐ Molecular, Cell, & Tissue Engineering
- ☐ Systems, Synthetic, & Comp. BioE.

Student

Name: _____

NUID: _____

This is my… (check one)

- ☐ **1st rotation**
- ☐ **2nd rotation**
- ☐ **Additional**

- **FUNDING (check one)**

- ☐ I have funding to support this student if he/she joins my lab.
  - Grant number: Expiration date:
- ☐ Grant application is submitted/scored. I expect to have funding to support this student.
- ☐ I will not have funding, but my department has agreed to support this student for years.
- ☐ I will not have funding to support this student joining my lab.

If you will not have funding, you and the student should discuss, and explain below, why you think this rotation is justified (e.g., the student wishes to learn a specific technique)

- **PROJECT**

Please provide a brief description of the project the student will be working on during their rotation.

- **SIGNATURES**

_____
Mentor Date

_____
Graduate Committee Area Chair Date

_____
Student Date

Graduate Student Post-Lab Evaluation Form (Post-rotation)

This form is to be filled out by lab rotation advisors after rotation students have completed each rotation. Please return to the Bioengineering Academic Operations Manager upon completion of the rotation.

To be completed by the student:

Rotation advisor's name: _____

Student name: _____

Rotation number: _____

Brief summary of what was accomplished during the rotation (1-3 sentences):

To be completed by the rotation advisor (PI):

Ratings (1 to 5, with 1 being need further development and 5 being best)

- Responsible, shows up to lab: _____ Works hard when in lab: _____
- Understands what they are doing and can summarize: _____
- Can execute experiments / analyze data / develop methods with minimal guidance: _____

Critical thinker: _____ Independently reads the relevant background literature: _____

Strengths of this student in the lab:

Please discuss what this student should work on to be successful in the PhD program:

Signature of rotation advisor (PI): _____

Signature of student: _____

Appendix D. PhD Advisor Declaration Form

Department of Bioengineering

PhD Advisor Declaration/Advisor Change Request Form

Student Name: _____

NUID#: _____ E-mail Address: _____

Advisor Declaration

Advisor Name (print): _____

Department: _____

Semester/Year Advisor's RA Support to Begin: _____

*Advisor's Index Number(s) for first two semesters of RA Support: _____

Advisor's Signature: _____ Date: _____

Advisor Change Request

Current Advisor Name (print): _____

Department: _____

Current Advisor's Signature: _____ Date: _____

Proposed New Advisor's Name (print): _____

Department: _____

Semester/Year New Advisor's RA Support to Begin: _____

*New Advisor's Index Number(s) for first two semesters of RA Support: _____

Proposed New Advisor's Signature: _____ Date: _____

Student Signature: _____ Date: _____

Approved by Bioengineering Graduate Director: _____ Date: _____

***Note to Advisor: Index numbers for advisor's support of subsequent semesters will be required at the time of SGA appointment requests.** After completing this form, submit it to the Bioengineering Academic Operations Manager and save a copy for your records.*

Appendix E. Bioengineering Qualifying Exam, Structure and Criteria

Format and some text adapted from:
https://bme.gatech.edu/bme/sites/default/files/graduate/BME-Qualifying-Exam-Mutual-Expectations-Document-and-Rubric.pdf
https://seas.harvard.edu/bioengineering/graduate-program/overview-phd-program/bioengineering-phd-oral-qualifying-examination
https://www.einsteinmed.edu/uploadedFiles/education/phd/timeline-to-qual-exam.pdf?version=2.0

I. Scope of the exam:

In order to maintain academic standing in the PhD Program, students must pass a comprehensive qualifying examination in one of the four department research areas to demonstrate preparedness to perform doctoral research and eventually complete a satisfactory PhD dissertation. The qualifying exam is normally taken in the student's second year in the program. In order to take the exam, students must demonstrate satisfactory research progress (as reported by their research advisor) and satisfactory academic standing (as indicated by their GPA). The exam includes written and oral components. Students will prepare a 6-page written document in the format of an NIH R21 proposal (as detailed below). This document needs to demonstrate creative thinking and should be focused on the subject of the student's own PhD thesis research and relevant topics at the laboratory where the thesis work will be performed. The oral portion of the exam will involve a presentation by the student of their written proposal and defense of the ideas included within. This exam will assess students' critical thinking, understanding of the fundamental background of their research, and ability to create a logical and rational experimental plan using engineering design principles. The qualifying exam does not require the student to have preliminary data, although presenting relevant preliminary data for explaining the proposed study is permitted and considered helpful.

II. Policies:

- Students taking the qualifying exam must be in good academic standing (i.e., minimum cumulative 3.0 GPA and not on research probation).

- The qualifying exam should be completed in the student's second year; special considerations may be permitted to delay depending on the student's specific background.

- A minimum of 6 months is required since the student joined their advisor's lab.

- Students are encouraged to discuss the scope of the project and relevant literature with an advisor and/or colleague.

- Students are permitted to have their fellow students and the NU CommLab provide feedback to their written proposal. However, the advisor is not allowed to read, edit, or provide feedback to the written proposal.

- The role of the PI - the PI may:
    - help the student develop understandings of the field and relevant literature
    - consult with the student about non-independent aims

- not comment on or provide feedback on the independent aim (as defined in the 'format' section)
- not write or edit any other part of the proposal

● The student's PI will be required to confirm that the written portion of the exam is derived from the student's own writing and not that of the PI.

● Plagiarism, i.e. verbatim copies or slightly modified text from written materials published by others, is considered severe academic misconduct and is strictly forbidden in all academic works at Northeastern, including qualifying exam reports. Please also note that self-plagiarism (i.e., to reuse or adapt previously published written materials developed or co-developed by the student) is also considered a form of plagiarism and is thus forbidden. All written examinations will be submitted via the Qualifying Exam Canvas site by the due date to undergo an originality check.

● Any verified plagiarism activities discovered in the written report may automatically result in a failure of the exam, and, possibly, dismissal from the PhD program.

● Students who fail their qualifying exam on the first attempt may have at maximum one additional opportunity to retake the exam in one of the following (fall/spring) semesters. Students may not take the qualifying exam more than twice.

● In some cases, a student may receive a "conditional pass" (only applicable to resolving issues identified from the written report), with clear instructions from the Qualifying Exam committee on additional actions necessary for passing.

● Any disagreements on the outcome of the exam shall be reported to and resolved by the graduate committee and department chair.

III. Qualifying Exam Committees:

The qualifying exam committee is composed of 3 faculty members. It is the student's responsibility to provide to the graduate committee a list of 4 faculty members, with their confirmed interest, and their affiliations as potential members of their qualifying exam committee prior to the exam. The committee should be composed of:

- Member 1: a core BIOE faculty member, including tenure/tenure-track/teaching and research BIOE faculty (All three members can be core faculty, more options listed below for the other 2 members)
- Member 2: a core or affiliated BIOE faculty member
- Member 3: a Northeastern faculty member (BIOE or non-BIOE faculty)).

The student is encouraged to discuss the list with their research advisor and should confirm faculty's interest and availability before submitting the list to the department. Members of the qualifying exam committee, and a committee chair, will be assigned by the Graduate Development Committee.

Because the qualifying exam aims to serve as a departmental evaluation of the student's research capabilities, the student's primary research advisor may **not** be part of the qualifying exam committee or be present during the examination.

Students can use their qualifying exam committee as a basis for their dissertation committee.

IV. Format:

Written component:

The student will submit a written proposal that includes an introductory review of the research field to be presented in the exam, motivation and potential impact of the proposed research field, specific research aims or goals, and any preliminary work towards these goals.

R21-style (6 pages, excluding references) document with:

- Page 1: 2-4 Specific Aims (at the student's discretion)
    - One of the aims must be fully independent
        - Independent aims are developed without consultation with the student's PI. This aim should still test the hypothesis and should incorporate ideas outside of the scope of their immediate laboratory. This aim will be assessed on originality and creativity. The remaining aims may be crafted in consultation with the PI
    - The remaining aims may be crafted in consultation with the PI
- Page 2-6: research strategies
    - Significance/Background (including identification of knowledge gaps)
    - Innovation
    - Approach - describing specifically the proposed research activities associated with each specific aim (one per subsection)
- Formatting guidelines:
    - 11 font size
    - 1-inch margins (all 4 sides)
    - Arial typeface
    - single-line spacing

- All figures and legends must be easily legible
- *A template will be provided*

The student should then prepare an oral presentation as described below and be ready to answer any related questions that may arise during the exam.

Oral component:

The student will present and respond to questions on their written document and the fundamentals of their proposed research

- The student gives a presentation (~45 minutes), explaining the background, rationale, related prior works, aims, and the proposed steps to achieve the desired target.
- If available, students are allowed to present preliminary data, although it is not a requirement. Students without substantial preliminary data should primarily focus on the scientific rationales and methods. One should never use fictional or hypothetical data in the exam.
- The committee may ask questions of clarification and elaboration throughout the presentation.
- The committee may also probe the student's knowledge on the fundamentals supporting the proposed research.
- The student will be asked to leave the room at the end of the exam, so that the committee may deliberate.
- The total length of the exam, including the time for the committee's close-door discussion, should be typically limited to 1.5 hours.

V. <u>Exam Timeline:</u>

- First week of the semester
  - Initial e-mail sent to students with full instructions and deadlines and link to the online form due in week 3; qualified students will be added to Canvas page
  - From the first day of the semester, students have two weeks to form their committees. Students are required to reach out to 4 faculty, with the aim of confirming 3 committee members and confirming their availability for the exam period.
  - *An email template will be provided for students to use*

    - Qualifying Exam Information Session held

- Third week of the semester
    - Student submit a google form including
        - Their 4 committee member names
        - Tentative proposal title
        - and begin writing. Students will have two weeks to complete the written report.
    - Deadline to request an in person, or hybrid, exam.

- Week 7: Graduate Development Committee will inform students of their committee and date/time of oral exam

- Week 8: All students will submit their written exams via Canvas
    - All submitted documents will be run through Turnitin

- Oral exam window will be Weeks 9-12 of the semester

Additional Notes:

- A roughly one-year gap between the qualifying exam (2nd year) and the proposal (3rd year) is recommended. This gap is critical to allow the student to have sufficient time for further development of their thesis proposal at the next milestone.
- Special circumstance for fellowship applicants: students may elect to delay to Spring with approval from and proof of fellowship submission e-mailed to Graduate Chair and Academic Operations Manager

VI. Bioengineering PhD Qualifying Exam Grading Rubric

Criterion	Satisfactory	Unsatisfactory	Criterion Summary
Criterion 1: Understanding of underlying bioengineering research and applications, ability to critically read, understand literature	Student demonstrates sufficient understanding of the background materials and the general research domain.	Insufficient background knowledge of field	Know what they are talking about; know the field and prior works
Criterion 2: identify knowledge gaps and unmet challenges	Identify the main challenge(s) to be addressed	Insufficient understanding of the knowledge gaps	Understand what problem(s) they are solving, and why
Criterion 3: Utilize a logical approach in the design and implementation of a research strategy to solve a complex bioengineering problem	Student demonstrates knowledge and application of design principles	Inability to describe how evaluation of the results will solve the problem	Everything has to be justified; use logic for decision making, can not be arbitrarily decided
Criterion 4: Apply quantitative/engineering skills appropriate for the specific research application/data to be generated.	Student appropriately uses quantitative analyses (including statistics, power analysis, modeling, and literature) to justify design decisions and parameters	Insufficient understanding of the quantitative analysis applied in the proposal. Student fails to provide rationales or justifications for specific design choices	Know how to use math, models, statistics and other scientific tools to solve the problem in hand
Criterion 5: Effective communication skills, including presentation, professionalism and scientific writing skills	Presentation materials and delivery are clear and well-organized. Understanding the questions and responding appropriately.	Presentation is not following the correct format. Student fails to address questions effectively.	Clear and well organized presentation and writing.

Written Exam: Pass / Conditional Pass / Fail

Comments:

Oral Exam: Pass / Fail

Comments:

Overall Decision: Pass / Fail

Appendix F. PhD Dissertation Committee & Proposal Defense Form

Department of Bioengineering Doctoral Degree in Bioengineering

PhD Dissertation Committee & Proposal Defense Form

Name: _____

Date: _____ NUID: _____

Dissertation Committee Composition

The Dissertation Committee composition should adhere to the following guidelines:

The committee should be composed of at least three Northeastern University members. The chair of the committee should be the student's primary advisor or a member of the Bioengineering core faculty. Two members of the committee must be core faculty from the Bioengineering Department. At least one committee member should be outside of the Department of Bioengineering; it is highly recommended to have an External Faculty member from another university or institute to serve as a member of the committee.

Dissertation Proposal Defense

The Dissertation Proposal should adhere to the following guidelines:

The Dissertation Proposal must be in the form of an NIH-style R21 proposal. The PhD Candidate must defend their Dissertation Proposal before the Dissertation Committee. Committee Members must receive the Proposal no later than 1 week prior to the meeting.

Proposal Title:

_____

Approved for Proposal Defense Requirement for the Doctor of Philosophy Degree

Dissertation Advisor Name (print):

_____

Signature: _____ Department: _____

Committee Member Name (print):

_____

Signature: _____ Department:

_____

Committee Member Name (print): _____

Signature: _____ Department: _____

Committee Member Name (print): _____

Signature: _____ Department:
_____

Committee Member Name (print): _____

Signature: _____ Department: _____

Student's Signature: _____ Date: _____

Approved by BioE Graduate Director: _____ Date: _____

After completing this form, please submit it to the BioE Academic Operations Manager and save a copy for your records.

Appendix G. Industrial PhD - Best Practices and Recommendations

Coursework Requirements

The coursework requirements for Industrial PhD students follow the normal degree requirements (Bioengineering Graduate Handbook Section 3.1).

Advanced Entry Students: Most Industrial PhD students have 'advanced entry' (AE) status, meaning that they have an MS in a related field, which significantly reduces course requirements (16 Semester Hours or 4 Courses). Some AE Industrial PhD students are unable to be physically on campus where most of our department courses are offered. In these cases, we recommend that AE Industrial PhD students take courses in Independent Study (BIOE 7978) with non-dissertation advisor faculty in different areas of research in our department. These can be literature reviews that can be done off site on the students' own time and will allow breadth and depth for the course requirements. There are also a small number of online courses that can be taken. Please note that the Independent Study course may be taken at most 3 times. AE students are required to take Principles of Bioengineering (BIOE 7000) and Math Methods for Bioengineering (BIOE 6200); students may petition to waive BIOE 6200 if they have a sufficient mathematical background.

Regular-Entry Students: Industrial PhD students entering with BS only (non-AE) are required to take a 32 Semester Hour course-load as specified in the Graduate Student Handbook. To meet this, students typically must be on campus about 20 hours per week for at least the first two years of their PhD.

Seminars:
All PhD students are also required to take the Seminar Course (BIOE 7390) two semesters, and enroll and present in Student Seminar (BIOE 7391) in their second and fourth years.Offsite students may choose to register for the course and view the seminars online, and presentations may be delivered remotely upon request. Student Seminars will be uploaded to the BioE Graduate Student Canvas Page for convenience.

Research Requirements

The core of the PhD program is research and scholarship. Qualifying exams, committee meetings, annual reviews and defenses must be performed "as normal" as described in the Graduate Handbook Section 3.2.

Research performed by PhDs who are employed at an outside company may present a number of unique challenges with respect to publication, conference presentations, and intellectual property. It is critical that students and potential PhD advisors discuss these issues at the beginning of the PhD, reviewing the agreement made between the company and Northeastern University. As a general rule, the PhD research should be research performed beyond the student's job-related research so that it may be freely publicly discussed. Some considerations include:

- *Where will the research be performed?*
- *What are the expectations for journal and conference publications?*
- *Will the student be able to present the research at internal seminars and meetings, as well as at academic conferences?*

Further questions should be addressed to the Department of Bioengineering Associate Chair for Research and PhD Programs and the PhD Network.

Appendix H. BIOE 7978 Independent Study Project Plan Form

BIOE 7978 (4SH) **PhD Independent Study Project Plan**

Form to be filled out by Project Faculty Advisor and the Student

Independent study should be completed with either a non-dissertation advisor faculty or if with the student's dissertation advisor, should be a distinctly different project from the dissertation research.

- For Industrial PhD for part-time students, the study can be literature reviews that can be done off site on the students' own time and will allow breadth and depth for the course requirements.

- In addition to this form, a petition form is required for independent study to count toward the student's degree. PhD students can petition to take the course a maximum of 2 times; advanced entry students a maximum of 3 times.

Steps to follow:

1. *Faculty advisor to complete this form*

2. *Student to e-mail this form to the BIOE Graduate Chair and the BIOE Academic Operations Manager*

3. *Once approved, a section will be created for the student to enroll in; student to fill out and submit a petition form with the completed Project Plan attached*

Name of Student: _____ NUID #: _____

Student's PI: _____

Year and Semester of Independent Study: _____

Name of Project Faculty Advisor: _____

Note- Instructor of record must be a Northeastern faculty member.

Project Curriculum (Abstract/Topics/Outline/Timeline):

Expected Level of Effort:

This is a 4 SH credit-bearing class and as such the work completed and the time commitment should be equivalent to a 4 SH class

Student Objectives, Deliverables, and Expected Results:

Grade Criteria:

Please note below how a student will be graded for this course. (E.g., This student will be graded on attendance, consistency of participation, assistance with any and all research required tasks, final paper/presentation, compliance with required safety and training)

Contingency Plans:

In case of emergency (i.e. restricted access to lab, materials, etc. or inability to complete intended research), please note how the course objectives may change.

I affirm that this project will constitute a learning experience comparable to PhD BIOE unrestricted elective course. I affirm that the student is receiving no other compensation for this research.

_____

Signature of student

_____

Signature of project faculty advisor