

# Department of Bioengineering



## Ph.D. Graduate Student Handbook

Graduate Group in Bioengineering  
University of Pennsylvania

## Bioengineering Ph.D. Graduate Student Handbook

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## Introduction

Welcome to the Bioengineering Department! This handbook is designed to give new Bioengineering PhD students a brief history and overview of the Bioengineering department at Penn along with important guidelines for successfully completing the Bioengineering PhD program. In addition to this handbook there are helpful resources available on-line;



- The Bioengineering Graduate Program Web Pages:  
<http://www.be.seas.upenn.edu>
- SEAS Academic Resources:  
<http://www.seas.upenn.edu/graduate/advising/index.php>
- Campus Express – where your Penn journey begins:  
<http://www.campusexpress.upenn.edu/>
- “The PennBook - Resources, Policies & Procedures Handbook”:  
<http://www.upenn.edu/provost/pennbook>
- Campus Resource Guide: [www.gsc.upenn.edu/resources/guide](http://www.gsc.upenn.edu/resources/guide)

The Graduate Group Chair, Dr. Ravi Radhakrishnan or the Graduate Program Coordinator, Kathleen Venit, can assist you with any special questions or individual concerns not covered in the handbook.

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It is the student's responsibility to be familiar with the rules, procedures, and requirements of the Department, SEAS, and the University of Pennsylvania.

## **University of Pennsylvania**

Founded by Benjamin Franklin in 1740 as a charity school for Philadelphia children, the University of Pennsylvania is one of America's first universities and one of its foremost institutions of higher education. Located in West Philadelphia, Penn offers its students one of the world's best research faculties and a major metropolis rich in history, tradition, culture and innovation.

Today, Penn is a national leader in interdisciplinary programs that combine academic theory with professional practice. Among the Penn programs that cross the traditional boundaries between academic and professional disciplines is the Institute for Medicine and Engineering and the Institute for Translational Medicine and Therapeutics.

Over 10,000 students are enrolled in Penn's 12 graduate and professional schools, many of whom are leaders in their fields. Penn is also an integral part of the West Philadelphia community, participating in a number of programs designed to enhance the livability and economic health of the area.

### **Bioengineering Overview**

The first Biomedical Engineering Program in the nation began in the mid 1920's as a collaboration between engineers and health professionals at the University of Pennsylvania. The first Ph.D. in Bioengineering in the United States was awarded from Penn's Bioengineering Graduate Group in 1953 and the Department of Bioengineering was formally approved by the University in 1973. Many of Penn's graduates hold academic positions in Biomedical Engineering or related departments at Universities throughout the world, and have played a leading role in defining the field. Other graduates have entered the biomedical industry and have become the primary driving force behind one of the fastest growing sectors of the economy in providing advanced biomedical products, which has saved lives and improved the quality of our healthcare system.

Today the Bioengineering department at Penn has 19 primary faculty, and more than 120 affiliated graduate group faculty who provide the core teaching and research environment for undergraduate, Master's, and PhD students. The department has consistently been ranked as one of the best Bioengineering programs in the country for preparing students for careers in industry, medicine, academia, and other fields related to biomedical technology. The success of the program is due to the dedication of the faculty in conducting both excellent teaching and outstanding research.

Penn's academic curriculum in Bioengineering provides a solid foundation in science and develops powerful methods for understanding basic physiological processes. Combining the resources of the University of Pennsylvania's School of Engineering, School of Medicine, School of Arts and Sciences, School of Veterinary Medicine, School of Dental Medicine, School of Nursing, and the University Hospitals, the department is pioneering in a broad range of research areas in Bioengineering.

## **Goal and Philosophy**

The Ph.D. curriculum provides training in engineering with focuses on biological and medical sciences. The program provides education in many areas of research, specific knowledge relevant to the student's research area, scientific and engineering fundamentals and current updates in the field of Bioengineering. The fundamental goal of Penn Bioengineering is to provide students with a broad, flexible curriculum that gives them experience with a wide range of subject areas and intellectual approaches, to prepare them to function creatively and independently in a diverse range of settings.

## **Administrative Structure**

### **Main Department Office and Packages**

The Bioengineering Main Department Office is located in 240 Skirkanich Hall. If you order packages for your research, please have them delivered directly to your lab.

If packages are shipped to the main department office, please pick them up promptly. Personal packages are **not** accepted at the BE Department Office.

### **Graduate Group Structure**

The graduate program in Bioengineering is administered by the Bioengineering Graduate Group under the auspices of the SEAS Associate Dean for Academic Affairs. The Graduate Group is comprised of the Bioengineering primary faculty members as well as faculty from other departments and schools throughout the University. This unique composition gives students the opportunity to work in emerging and interdisciplinary areas that are relevant to Bioengineering. The current members of the BE graduate group and their research areas are listed on the Department's website: <http://www.be.seas.upenn.edu/about-research/grad-group.php>

## **Advisors**

The first person with whom a new PhD student has contact is the Bioengineering Graduate Group Chair. The Bioengineering Graduate Group Chair arranges each new student's laboratory rotations and will also assist students in developing a program of study for their first year.

Some students will directly match to a laboratory and their research mentor will help provide this guidance immediately when they enter Penn. For students completing a rotation, once a lab is chosen the student's advisor will be responsible to assist with future course selection plans and guide the student's dissertation research.

## **The Graduate Environment**

The spirit and size of the Department of Bioengineering fosters a close interaction between the graduate students and the entire faculty. This enriches the quality of student-faculty communications and the academic environment to benefit both learning and discovery. Every effort is made to create an environment of scholarship, creativity and learning, which is the very essence of graduate study.

Apart from offering advising, seminars, and informal meetings with the Department Chair and Graduate Group Chair to solicit student input and exchange information, the Department strongly supports the Graduate Association of Bioengineers (GABE). GABE ([www.seas.upenn.edu/be/gabe/index.html](http://www.seas.upenn.edu/be/gabe/index.html)) is a student-run association that represents the entire graduate student community in BE, and organizes both social and professional Bioengineering development events, sometimes in collaboration with the student chapter of BMES (Biomedical Engineering Society, [www.bmes.org](http://www.bmes.org)).

GAPSA is the University wide student government for all graduate and professional students at the University of Pennsylvania. There are many University wide affinity groups supported by GAPSA (e.g. LGBT, BGAPSA, LaGAPSA, Chinese Students and Scholars Association at Penn). For more information please visit [www.gapsa.upenn.edu](http://www.gapsa.upenn.edu)

## **General Information**

The Penn Bioengineering Graduate Group offers students a broad education that enables them to work, develop, and lead in bioengineering practice and research: within either traditional engineering and research environments, or in non-traditional multidisciplinary environments at the interface between engineering and a diversity of fields, including medicine, the life sciences, business, and law.

## **Registration, Leave of Absence**

Graduate students in Bioengineering have a wide variety of interests, and the BE graduate program is designed to encourage these interests. Some students prefer to take technical courses primarily within the Department; others desire to take a number of courses in other engineering or science departments. All graduate students must complete the "Permit to Register Form". The advisor or Graduate Group Chair must approve of course selection and sign the form to give a student permission to register. Please submit the completed form to the Graduate Program Coordinator's office (240 Skirkanich Hall) for processing.

This Permit to Register form can be found on the BE PhD Student Forms Website at: <http://www.be.seas.upenn.edu/current-students/doctoral/forms.php>. This form should be submitted prior to registering for courses. All students should register during Advance Registration. Dates for advance registration for the Spring and Fall semester can be found on the Academic Calendar. The academic calendar is on-line at: <http://www.upenn.edu/almanac/3yearcal.html>

All students enrolled in a degree program are required to be continuously registered. Three or four graduate course units (CUs) per semester (including dissertation research, such as BE 999) is considered to be a normal, full-time load for all students. Students must consult with the Graduate Group Chair if a deviation from the normal load is contemplated. Part-time students usually take one or, at most, two courses per semester. BE 999 is the course number assigned to dissertation research. Section numbers for BE 999 are assigned according to each advisor's name. The section numbers for BE 999 will be distributed by the Graduate Program Coordinator during the advance registration time period. Several units of this course may be taken simultaneously. The student's dissertation advisor assigns grades for BE 999. Only grades of "S" (satisfactory), "U" (unsatisfactory) or "I" (incomplete) can be earned in this course.

Continuous registration as a graduate student is required unless a formal leave of absence is granted. All students who desire a leave of absence must submit a request to the Graduate Group Chair. The petition for leave of absence can be found at: [www.seas.upenn.edu/forms](http://www.seas.upenn.edu/forms).

### **Changes in Registration**

Students may add or drop courses without penalty in any semester if it is done by the deadline. The student should discuss all changes in registration with his/her advisor and receive approval before making any changes. Approval should be communicated via email to the Graduate Program Coordinator before making any changes to the registration.

### **Policy on Childbirth and Adoption Accommodation for Ph.D. Students**

A student in the Ph.D. program at Penn is eligible for a "Time Off" period of eight weeks for the birth or adoption of a child. The student must notify the Graduate Group Chair and Advisor/Supervisor in writing, at an early date, of his/her plans to initiate a "Time Off" period, so that appropriate arrangements can be made to cover any teaching/research responsibilities.

Normally the "Time Off" period commences within two weeks of the birth or adoption. During the "Time Off" period, the student remains enrolled full-time. In order to facilitate a rapid return, s/he may participate in the program as fully as s/he deems appropriate. By remaining on full-time status, student visa status and loan repayment schedules, if any, will remain unchanged. The student is entitled to academic accommodation including relief from academic requirements, such as postponement of exams and course requirements. A student receiving stipend support is entitled to continuation of support during the "Time Off" period as follows:

1. Students receiving stipends from University/school funds are entitled to draw support for eight weeks during the academic year.
2. Students funded by government grants or other external funding sources are entitled to benefits as determined by the funding agency.

### **Family Leave of Absence Policy**

A student in the Ph.D. program at Penn may take an unpaid Family Leave of Absence for the birth or adoption of a child, child care, or care of an immediate family member (spouse, domestic partner, child, or parent) with a serious health condition.

1. Students may take a Family Leave of Absence for one or two semesters. The student is expected to notify the Graduate Group Chair and adviser in writing of his/her plans to take a Family Leave at an early date, so that appropriate arrangements can be made to cover any teaching/research responsibilities. Family Leave "stops the clock" on the student's academic requirements, including service requirements, for the duration of the leave. During the period of Family Leave, the student may arrange to continue Student Health Insurance, but is responsible for the payment of his or her own premiums. Upon paying a fee, students on approved Family Leave will retain their PennCard, e-mail

accounts, library privileges, and building access. Funding commitments from the institution are deferred until the student returns from Family Leave. Students receiving funding from external sources, such as government grants, are subject to the conditions established by the funding source. Service requirements (e.g., teaching, research) will be met by the student following return from Family Leave. Requests for extension of Family Leave beyond one year, or for repeated Family Leaves, may be made. Approval of an extension, deferral of funding, and continued academic accommodation is at the discretion of the Graduate Dean.

## **Academic Forms**

Important forms created specifically for the needs of students enrolled in the BE PhD program are found here:

<http://www.be.seas.upenn.edu/current-students/doctoral/forms.php>

These forms include the BE PhD Permit to Register form, BE 899 Independent Study Form, Laboratory Rotation Evaluation form, Qualifying Exam Forms, Dissertation Proposal Forms, and the Annual Dissertation Progress Report form.

All SEAS Academic Forms including the Petition for Action, Petition for Leave of Absence, Transfer of Credit and Transfer of Graduate Group and the Application for Graduation can be found at <http://www.seas.upenn.edu/graduate/advising/forms-g.php>

## **Grades, Credits, and Academic Standing**

The grading system for graduate courses is A+ through F. If a student receives an F, the course must be taken again; however, the F remains on the student's record. Courses for which a passing grade was obtained cannot be taken again for credit.

Doctoral students in the School of Engineering and Applied Science are expected to maintain at least a B average (3.0) in their work. A student whose record falls below a minimum of a B average will be put on academic probation and may be required to withdraw; graduation requires a minimum of a B average (exclusive of dissertation credits). Requirements cannot be satisfied by auditing courses or receiving an incomplete (I) grade.

## **Degree Requirements**

Degree Requirements can be found in the University of Pennsylvania Doctoral Dissertation Manual. The Manual can be found on-line at:  
[http://www.upenn.edu/provost/dissertation\\_manual](http://www.upenn.edu/provost/dissertation_manual)

Detailed academic rules and regulations are issued by the Office of Graduate Studies for the Graduate Council of the Faculties. These rules can be found on the following website: [http://www.upenn.edu/provost/category/penn\\_policies](http://www.upenn.edu/provost/category/penn_policies) It is the responsibility of the Ph.D. student to become familiar with all of the degree requirements in addition to those discussed in this document.

The General Bioengineering PhD requirements include:

- The successful completion of the course requirements, a grade-point average of at least 3.0.
- Satisfactory performance in the Ph.D. Qualifications Evaluation.
- Successful completion of the PhD Candidacy Examination, consisting of submission and defense of the dissertation proposal.
- Annual Dissertation Progress Report
- The submission and successful defense of the completed dissertation according to the University Doctoral Dissertation Manual.

## **Course Requirements**

All doctoral students are required to take the following:

- 2 courses in Biomedical Science. Many students take one course in cell biology and one course in systems physiology to broaden the student's biological background and emphasize the quantitative aspects of living systems. Courses should be chosen in consultation with the advisor.
- 3 course units in Bioengineering Fundamentals. Bioengineering and Engineering courses devoted to analytical methods, modeling as well as experimental methods and data analysis. These courses should be chosen in consultation with the advisor, focusing on the concentration.
- 2 Research Discipline Specific Courses. These courses should be chosen in consultation with the advisor.
- 2 course units in Mathematics. Suggested courses include: ENM 510, 511, ENM 502, BE 510
- Bioengineering Seminar. A minimum of 2 semesters is required (BE 699) (.5 cu each), usually in the first year.
- Dissertation Research, Balance of University Requirements BE 999
- TOTAL \* 9 courses and 2 seminars

## **General Plan of Study**

The following table indicates a general sample plan of study. Students should discuss specific course selection with their advisor. Suggested course plans for training in specific areas of concentration such as neuroengineering, cell and tissue engineering, injury biomechanics, biofluid mechanics, orthopaedic biomechanics and biomaterials, and imaging are detailed on-line at: <http://www.seas.upenn.edu/be/phd/areas.html>

	Fall	Spring
Year 1	<ul style="list-style-type: none"> <li>• Biomedical Science Course</li> <li>• Math or BE Fundamentals</li> <li>• 1 CU of BE 999-Dissertation Research</li> <li>• BE 699 - Bioengineering Seminar (.5 cu)</li> </ul>	<ul style="list-style-type: none"> <li>• BE Fundamentals Course</li> <li>• Biomedical Science or BE Fundamentals</li> <li>• 1 CUs BE 999 – Dissertation Research</li> <li>• BE 699 – Seminar (.5 cu)</li> <li>• <b>Qualifications Evaluation completed during the Summer</b></li> </ul>
Year 2	<ul style="list-style-type: none"> <li>• Math Elective</li> <li>• BE Fundamentals or Biomedical Science Elective</li> <li>• BE 999</li> </ul>	<ul style="list-style-type: none"> <li>• BE Fundamentals</li> <li>• Bioengineering Elective</li> <li>• BE 999</li> <li>• BE 699</li> </ul>
Year 3 and beyond	<ul style="list-style-type: none"> <li>• BE 999</li> <li>• BE Fundamentals</li> <li>• <b>Dissertation proposal by the end of the Fall semester of the 3<sup>rd</sup> year</b></li> </ul>	<ul style="list-style-type: none"> <li>• Annual Progress Report due June 1</li> <li>• Dissertation Research – BE 995</li> <li>• Final Examination &amp; Dissertation Defense</li> </ul>

### Ph.D. Timeline

The normal timeline for a Ph.D. student is outlined below:

- Most students will complete lab rotations and choose an advisor by the end of the Fall semester of their first year.
- Students will complete the Qualifications Evaluation over the summer of their first year.
- Students will form a dissertation committee together with their advisor during their second year of study.
- Students will complete the PhD Candidacy Exam, consisting of the submission and oral defense of the dissertation proposal during the fall of the third year of the program (by the end of a student's 5<sup>th</sup> semester).
- Upon Advancement to Candidacy, each student has a Dissertation Committee. The committee should meet annually and the student must prepare an Annual Dissertation Progress Report to be approved by the supervisor and submitted to the Graduate Group Chair to be documented for the student's academic record. This report should be signed by your committee and submitted at any time following your committee meeting. The final deadline for submitting the report is June 1<sup>st</sup> but the report is accepted at any time prior to the deadline.
- Most students will complete the program in 5 or 6 years

## **Course Planning Guide**

It is recommended that each student bring a completed copy of the Course Planning Guide (CPG) to the Qualifications Evaluation, PhD Candidacy Exam and the Dissertation Defense. The CPG is very helpful in determining whether or not you have met the requirements of the program. The CPG can be found towards the end of this book and on the department web site. It is the student's responsibility to bring a completed CPG and transcript to each evaluation and exam.

## **Course Selection Approval**

No courses shall be taken without the prior approval of the student's advisor or the Graduate Group Chair. No advisor hold on registration will be removed without a completed and signed "Permit to Register Form".

## **Policy on Transfer Credits Earned in Other Institutions**

A maximum of nine graduate-level course units taken at another university may be accepted provided that the grade received in each course was at least a B and did not count toward an undergraduate degree. All transfer credits are subject to approval by the Graduate Group Chair and the Associate Dean for Academic Affairs. The student who wishes such credit transfer must complete and submit a "Transfer of Credit Petition" found on-line at: [www.seas.upenn.edu/forms](http://www.seas.upenn.edu/forms). Attach a copy of the complete transcript to the transfer of credit petition. Submit the petition and information to the Graduate Group Chair. For each transfer course, obtain the course description and the title of the textbook prescribed for the course and identify the similar course at Penn that would match the transfer course (the Graduate Group Chair may contact the Penn faculty member teaching the course for approval).

\*Please note that a student may not receive credit for a course taken at the undergraduate level if that course counted toward an undergraduate degree.

## **Independent Study – BE 899**

Independent study allows the student to create a customized curriculum to study material beyond or outside the scope of our standard BE offerings. The student should identify the independent study topic, faculty mentor and scope of the independent study. Prior to the beginning of the semester in which the student contemplates taking the independent study, the student and his/her independent study faculty mentor should complete the Independent Study Proposal Form. The form must be signed by both the student and his/her independent study faculty mentor, and it should be submitted to the graduate group chair for approval before the beginning of the semester.

Independent studies are less structured than regular courses but are no less rigorous. They must adhere to the following guidelines:

- An independent study course should require an effort comparable to that of a regular course, about 9 hours a week or a total of 126 hours per semester.

- The student should meet the faculty member administering the independent study (the advisor) on a regular basis, at least once a week. It is the student's responsibility to schedule these weekly meetings. Past experience indicates that failure to maintain regular contact with the student's advisor often has led to a less than satisfactory performance in the independent-study course. In the absence of regular contact, the student stands the risk of not being focused leading to an impression of dereliction. The key to a successful independent study is a steady effort throughout the semester. The student should not expect to be able to cram a semester's work into a few days of intensive work at the end of the semester.
- At the conclusion of the independent study, the student should prepare a brief report specifying what material was covered during the independent study, those objectives that were met and those that were not. In the event that objectives were not met, a clear explanation should be provided as to why such objectives were not met. This document should also be signed by the student and his/her independent study faculty mentor, and it will form a part of the student's file.
- It is the student's responsibility to make sure that these guidelines are followed. Failure to follow these guidelines may result in the student not receiving credit for the independent study.
- The BE 899- Independent Study Form can be found on-line at: <http://www.be.seas.upenn.edu/current-students/doctoral/forms.php>

### **BE 699 - Seminar course**

The seminar course has been established so that students get recognition for their seminar attendance as well as to encourage students to attend. The course is offered Fall and Spring every year. The grading system is S/U (Satisfactory/Unsatisfactory, these grades do not affect the GPA), 0.5 cu per semester.

All BE graduate students are required to register for BE699 during two semesters before graduation, preferably in the first year. Students will register to 4.5 cu in semesters when they are taking BE699.

- Each student must attend eight seminars per semester. All students will be required to submit a summary of each seminar attended. All summaries should be submitted by the end of the semester to the BE Graduate Coordinator.
- At least four seminars must be officially designated "Bioengineering Department Seminars". All BE seminars fall into that category, but dissertation defense seminars are excluded.
- The four "other" seminars may be any combination of department, research group, or other technical seminars on campus. Formal dissertation defense seminars qualify in this category.
- Students may get credit for up to 2 "other" seminars if they attend a full session at a conference in their field subject to their academic advisor's endorsement. Only conferences during the semester when BE699 is taken qualify for credit. Students should provide the course coordinator with the session program.

## **Pedagogical Training**

Participation of graduate students in the teaching mission of the department develops their teaching, presentation, leadership, and interpersonal skills while assisting the department in discharging its teaching responsibilities. However, this is not a requirement for completion of the PhD degree. Typically students lead tutorials, supervise undergraduate laboratory experiments, develop instructional laboratories, develop instructional materials, and/or grade homework, laboratory reports, and exams. Finally, Penn's Center for Teaching and Learning ([wwwctl.sas.upenn.edu](http://wwwctl.sas.upenn.edu)) offers teaching workshops and a teaching certificate for interested students.

## **Time Limit for Completion of the Ph.D.**

The University's maximum time limit for completion is ten years after matriculation. Graduate students who have been dropped after 10 years may petition the graduate group to return as a student for a maximum of one year in order to achieve recertification and defend the dissertation. The faculty have no obligation to continue working with a student who has been dropped, nor is there any presumption that a graduate group will respond favorably to a petition for re-admission. If the Graduate Group wishes to recommend re-admission, it must present to the Graduate Dean a list of faculty members willing to serve as a dissertation committee and a detailed, realistic plan of how the student will, within one year of reenrollment, achieve recertification, pass the dissertation examination, and submit the final copy of the dissertation. If re-enrollment is approved by the Graduate Dean, such a student must pay reduced rate tuition for two semesters, unless all requirements are completed within one semester.

## **Recertification**

Students who have not completed all requirements for the Ph.D., including the deposit of the dissertation, within 10 years of their initial matriculation face the ever increasing risk that their knowledge of the field is no longer at the frontier of current research in their field. A student who is re-enrolled after expiration of the time limit must therefore satisfy the recertification criteria designed by their Graduate Group and approved by the Graduate Council of the Faculties (or retake and pass the Candidacy Examination). The new deadline for completion of all requirements for the Ph.D. including recertification shall be within one year.

## **Qualifications Evaluation Policy**

The purpose of the Qualifications Evaluation is to determine whether the student has demonstrated the ability to identify a research question, formulate a testable hypothesis parse the project into testable aims, and articulate a limited set of experiments to address these aims. The student is expected to recognize the strengths, weaknesses, and feasibility of the proposed approach. The student will also be evaluated for basic knowledge in the field of research, and ability to think logically and communicate effectively in both written and oral formats. The student is not expected to have substantial preliminary data for the written or oral examination.

## **Procedure for Qualifications Evaluation**

All graduate students are required to complete the Qualifications Evaluation within the first 14 months of their residence (typically during the first summer, but by Nov. 1 at the very latest). The Qualifications Evaluation requirements include: 1) preparing a written proposal, and 2) presenting and discussing the proposal during an oral examination by a committee of 3-4 members of Penn's Bioengineering Graduate Group.

### **Student Guidelines and Timeline**

Any doctoral student intending to complete his/her qualifications evaluation in their first year must attend a meeting with the Graduate Exams Committee co-chairs in the Spring of that year for specific instructions. The student, in consultation with his/her advisor, should identify a two-week window during which the written document for the qualifier will be prepared. This period of time must be formally submitted to the Graduate Exams Committee via an online form (<http://www.seas.upenn.edu/be/phd/quals.html>). The student's advisor will be required to confirm the timeframe through a complementary web page.

The student will receive the general topic for his/her qualifier by e-mail at noon on the first day of the 14-day period and will also be informed of the members of the committee (3-4 faculty in the Bioengineering Graduate Group) that will judge the written and oral components of the student's qualifying exam. During this two-week period, the student must also coordinate a date and time for the oral component of the qualifier exam with his/her advisor and committee members (to be held no earlier than 16 days after submission of the written document). The student must e-mail the final qualifier document, exam evaluation forms, as well as the finalized date for the oral presentation, to their exam committee and Kathleen Venit ([kvenit@seas.upenn.edu](mailto:kvenit@seas.upenn.edu)) by noon on the last day of this two-week period. The student has to comply with this first deadline for successful completion of the exam.

The student then has another 14 days (immediately following the first 14-day period) to work on the presentation, which is to be delivered on the day the committee meets. At the end of the 28 days, the student is allowed to submit a 1-page written update on the qualifier, indicating any changes or clarifications; this is optional and gives the student an opportunity to address any significant change in thinking that arose while preparing the presentation. The update has to be e-mailed to Kathleen Venit and the exam committee by noon on the 28th day.

While preparing the qualifier (both written and oral components), the student is not to consult peers, the advisor, or anyone else. No scientific help is allowed. Kathleen Venit, the Graduate Exams Committee Chairs, and the Bioengineering Graduate Group chair will provide administrative guidance, if necessary.

The student makes a presentation to the committee of 3-4 and the committee evaluates both the written and oral parts according to the guidelines stipulated by the Graduate Group. The student must bring the oral evaluation form to the meeting. In addition to the committee, a member of the Graduate Exams Committee may be present at the exam to ensure homogeneity in the process.

The committee will meet immediately after the exam in the absence of the student to discuss the student's performance and to make its recommendation. Possible outcomes are: (1) successfully completed, (2) conditional pass – has to re-write the proposal (within 14 days), (3) has to retake the entire exam, or (4) failed. The results are approved by the Exam Committee Chair and communicated to the student.

### **Formatting Guidelines**

Spring semester	Graduate Exams Committee Chair meets with students to discuss the expectations and timeline of the qualifier exam.
May 15th	The two-week window during which the student will prepare the written document and ranked areas of concentration must be submitted through an online form by this date. Advisor approval of the timeframe and the concentration areas must also be submitted by this date as well.
October 31st	All qualifier examinations must be completed by this date.

*Example: If two-week writing period is June 2nd – June 16th:*

June 2nd	At noon, student will receive an e-mail with the research topic and names of the committee members. Student should prepare written document and finalize date for oral presentation during the next 14 days.
June 16th	By noon, student must e-mail Kathleen Venit and committee members the qualifier document and date of the oral presentation. Student can begin work on the oral presentation and, optionally, the 1-page written update.
June 30th	By noon, student must e-mail the presentation slides and the 1-page written update, if applicable, to Kathleen Venit and committee members.
July 02nd (or before Oct. 31)	Student gives oral presentation.

*Students are strongly encouraged to schedule qualifier as soon as possible to minimize conflicts with coursework and schedules of committee members!*

The written document should take the form of an NIH proposal, including sections for Specific Aims, Significance, Innovation, Approach, and Literature Cited. The proposal should be no longer than 7 pages, using at least 0.5" margins, single spacing, and 11-point font (preferably Arial). As a rough guideline, one page should be used for Specific Aims, one page for Significance and Innovation, and five pages for Research Design and Methods. The Literature Cited section does not count towards the page limit.

Your oral presentation should last 10-15 minutes when uninterrupted. It is recommended that you include no more than 10 slides, excluding the title slide.

Additional information about the Qualifications Evaluation can be found on line at:  
<http://www.be.seas.upenn.edu/current-students/doctoral/index.php>

## **PhD Candidacy Examination - Submission and Defense of the Dissertation Proposal**

*To be eligible for the PhD Candidacy exam, a student must have passed the Qualifications Evaluation and be in good academic standing. All Ph.D. students should defend their dissertation by the end of the fall semester of their third year of graduate studies.*

### **Step 1: Getting Started - Registration for Your Dissertation Proposal Defense**

Before the third year, each student and advisor should identify a dissertation research topic, select potential committee members, and develop a timeline to defend their dissertation proposal by the end of the fall semester of their third year of study. All students must formally register for the Dissertation Proposal Candidacy Exam (registration form found online at (<https://be.seas.upenn.edu/secure/web-forms/dissertation-proposal.php>) by the end of the fifth semester of graduate study. If the student took a leave of absence during his/her studies, or believes he/she may have other extenuating circumstances, contact the Graduate Program Coordinator so that a timeline to defend the proposal can be determined based on individual circumstances.

### **Step 2: Registration Review-Committee Approval and Appointment of Chair**

The Graduate Group Chair will review the topic, committee members and timeline proposed on the registration form. After reviewing your registration and committee recommendations, the Graduate Group Chair will appoint your Dissertation Committee Chair. Changes or additions to the committee require approval of the Graduate Group Chair.

#### **Guidelines for selecting your committee:**

##### Dissertation Committee Composition

1. Committee shall typically be composed of 3-4 faculty members (in addition to the advisor), recommended by the advisor, and approved by the Bioengineering Graduate Group Chair. In special circumstances, an additional member may be added, subject to the approval of the Graduate Group Chair. Appointment of committee members who are not part of Penn faculty requires details of their full title, affiliation and a short biographical sketch.
2. The dissertation advisor is an ex officio member of the committee.
3. Three committee members must have full-time Standing or Research faculty appointments at Penn.
4. Two committee members must be members of the Bioengineering Graduate Group.
5. One committee member must hold a doctorate in an Engineering discipline or a highly quantitative subject (e.g. math, physics), OR be a Primary Faculty member in a School of Engineering and Applied Science Department.
6. One member (who meets the criteria listed below) is recommended as Chair by the advisor, and must be approved by the Bioengineering Graduate Group Chair.

##### Qualifications of Dissertation Committee Chair (must satisfy all criteria):

1. Is member of the Bioengineering Graduate Group
2. Is a member of the Standing Faculty of the University of Pennsylvania

3. Has served as a member or advisor on the *proposal defense* of at least one University of Pennsylvania Bioengineering dissertation committee previously.
4. Is NOT the advisor of the student.

### **Responsibilities of Dissertation Committee Chair:**

At every stage, verify that the dissertation meets the Bioengineering requirements for rigorous engineering and biomedical science content. Discuss any concerns in this regard with the student and advisor, and contact the Bioengineering Graduate Group Chair when concerns arise.

1. Ensure that the content and tone of the proposal defense, annual committee meetings, and dissertation defense meeting are constructive for the student and advisor. If the student and advisor have difficulty in scheduling meetings in a timely manner. The Committee Chair will contact the Bioengineering Graduate Group Chair to recommend replacement of committee members with limited availability.
2. At each meeting of the committee, review the student's course planning guide and transcript (both must be provided by the student) to ensure the student is meeting Bioengineering course requirements in a timely manner. Inform the advisor and Graduate Group Chair of any concerns, and include committee recommendations for additional coursework in the official meeting report.
3. At each meeting of the committee, ensure that proper forms are completed with comments to the student, signed by all members of the committee, and submitted to the Graduate Group Coordinator.

### **Step 3: Write your proposal - and have your advisor read, edit and approve it.**

The advisor must approve the dissertation proposal before it can be distributed to the committee. The dissertation proposal is based on the NIH application format, and should have the following sections: Cover page including title, student and advisor name and contact information, Table of Contents, Abstract (<1 page), Specific Aims (1 page) and Research Strategy (12 pages). There is a 13-page limit, single-spaced with minimum font size of 11, excluding the Cover Page, Table of Contents, Abstract and References. The **Specific Aims** section states the specific objectives of the research proposed (e.g., to test a stated hypothesis, create a novel design, solve a specific problem, challenge an existing paradigm or clinical practice, address a critical barrier to progress in the field, or develop new technology). The **Research Strategy** section includes subsections: **Significance** (e.g importance of the problem and how project will improve scientific knowledge, technical capability), **Innovation** (e.g. methods, instrumentation, theories, etc.), and **Approach** (overall strategy, methods and analyses, as well as preliminary data, potential problems and alternative strategies). This format emphasizes scientific and technical merit of the proposed studies, with less emphasis on preliminary data.

### **Step 4: Schedule the Proposal Defense Date/Location**

Concurrent with the final stages of writing, the student should schedule a date for the examination, allowing a minimum of two weeks for the proposal to be reviewed by the committee. The student should copy his/her advisor on all correspondence with committee members. To facilitate rapid convergence on convenient meeting time and dates, students should find 5-7 dates/times that work for the student and advisor, and use

meeting planner websites (e.g. [www.doodle.com](http://www.doodle.com), [www.surveymonkey.com](http://www.surveymonkey.com)) to help schedule the exam. If the student has continued difficulty scheduling an exam due to an unresponsive committee member, he/she should inform the advisor for help. If the member is non-responsive for more than a week, do not hesitate to contact the Graduate Program Coordinator or Graduate Group Chair to expedite the scheduling of the oral exam.

When the student has finalized a date, he/she must inform the Graduate Program Coordinator. Meeting rooms can be reserved through the SEAS Room Reservation Request Form found on-line: <https://www.seas.upenn.edu/about-seas/room-reservation/> If a student needs assistance reserving a room he/she should contact the Graduate Program Coordinator. The student should send an email to all committee members with confirmation of the date and meeting place. The student will send a reminder to all committee members of the time and place of the examination one week before the meeting. The Graduate Group Chair and Graduate Program Coordinator should be copied on the reminder, which can be distributed by e-mail. The student must also prepare and bring the proper paperwork for the proposal meeting. This includes a CPG, updated transcripts and the Acceptance of Dissertation Proposal Form found on-line at: <http://www.be.seas.upenn.edu/current-students/doctoral/forms.php>

If there is a need to change the meeting time of the presentation the student must confirm these changes with committee members and make sure that everyone is agreeable to the change. The student must also inform the Graduate Program Coordinator and the Graduate Group Chair of any changes that are made.

### **Step 5: The Dissertation Proposal Defense**

The Oral Presentation period of the dissertation defense should last approximately 45 minutes and will be followed by a question-answer period of similar length. Adjustments may be made with regard to the length of the presentation and subsequent discussion based on committee discretion, but the student should tailor his/her presentation roughly to these guidelines. The exam room should be reserved for two and a half hours to also allow the committee time for evaluation and discussion. The committee chair will report the recommendations to the Graduate Group Chair on the form provided by the student. The Acceptance of Dissertation Proposal form can be found on-line here: <http://www.be.seas.upenn.edu/current-students/doctoral/forms.php>

It is imperative that all committee members be present at the oral presentation. If a member of the committee is unable to attend, the student must obtain approval of the committee chair and Graduate Group Chair to go on with the proposal. In this case, the absent member will be required to send comments to the Committee Chair two days prior to the presentation. At the Committee Chair's discretion, these comments or questions may be used during the exam to test the candidate's knowledge of the subject area.

The dissertation advisor is an ex-officio member of the committee and should always be present at the examination and at all meetings of the committee. However, the advisor must allow the student to demonstrate his/her knowledge and command of the subject on his/her own and will be recognized by the committee chair only to clarify issues when requested by a committee member.

## **Step 6: Feedback from the Dissertation Proposal Defense**

The student may be informed orally on the outcome of the dissertation proposal defense following the examination. Written confirmation of the outcome will follow after the Committee Chair returns the examination approval form to the Graduate Program Coordinator. The committee may request revisions to the proposal, accept it as is, or fail the student. The dissertation committee must accept the proposal before the student advances to Candidacy.

**NOTE:** Students who have not defended their dissertation proposal and passed their Candidacy Exam by the end of the Fall semester of their 3rd year of graduate studies must petition to the Graduate Group Chair for an extension. The petition should explain why a proposal was not submitted and provide a schedule for submission. The University regulations state that the maximum time limit for a student to “Advance to Candidacy” is five years, after which time the student will be dropped from the rolls. Dissertation proposals must be defended and approved at least 12 months before the Doctoral Dissertation is submitted. The Graduate Group Chair will not accept a Doctoral Dissertation before this period has passed.

### **Annual Dissertation Progress Report**

Upon Advancement to Candidacy, additional meetings of the dissertation committee should be scheduled every 6-12 months to update the committee either in response to the suggestions made during the defense, during dissertation research, or in preparation for the final dissertation presentation. At a minimum, the committee must meet once annually with the student to review the student’s progress. During that meeting, the student will also be given an opportunity to meet with the committee alone should there be a need for discussion. It is required that the student prepare an Annual Dissertation Progress Report for this meeting and the committee must give timely feedback (within one month) and confirm whether the progress is satisfactory. A copy of the signed progress report is submitted to the Advisor and Graduate Group Chair. This form can be found at: <http://www.be.seas.upenn.edu/current-students/doctoral/forms.php> and it is the responsibility of the student to ensure the form is completed by the dissertation committee. The report should be submitted immediately following the meeting, or at any time before the June 1<sup>st</sup> deadline. The student should arrange these meetings as he/she did the proposal defense and in consultation with the members of the committee. In special circumstances the Graduate Group Chair may also ask the dissertation committee to reconvene.

## **Final Examination and Dissertation Requirements**

### **1. Doctoral Dissertation**

Upon completion of the research program, as determined by the student and advisor, each student must prepare a doctoral dissertation that is read by the dissertation committee and defended in a public presentation. The dissertation must follow the rules and format

stipulated in the "Doctoral Dissertation Manual" issued by the Office of the Vice Provost for Graduate Education, available online at:

[http://www.upenn.edu/provost/dissertation\\_manual](http://www.upenn.edu/provost/dissertation_manual)

Although strict style guidelines have not been set by the Bioengineering Graduate Group, it is stressed that the requirements of all good scientific writing, i.e. clear logic, clear and grammatically correct writing, and common sense in the presentation, should be followed. In general, the student should also consult previous Ph.D. theses available in the library for guidance as to how to best solve problems of presenting voluminous data, graphs, equations, etc., that are often encountered in an engineering dissertation. The importance of good organization, with appropriate chapter subheadings as required, cannot be over emphasized, since the reader is faced with the problem of assimilating and critically assessing a great deal of information. Students should also be cognizant that significant differences in styles exist for theses in engineering and the life sciences; although Bioengineering spans both, at Penn the Bioengineering Ph.D. is an engineering degree and students should follow that model.

It is the responsibility of the dissertation advisor to ensure that the written copy of the dissertation submitted to the committee meets the above basic requirements.

## **2. Submission of Doctoral Dissertation to Dissertation Committee**

In order to submit the dissertation, it must be in its final form, i.e., typed, with final drawings, and complete with references and appendices.

When the advisor approves the dissertation, it is time to send it to the committee and schedule the public defense. The student must allow sufficient time for the reading of the dissertation by the committee, the final examination, and possible revisions and rereading; otherwise the student may be required to register for another semester to complete the process. Specifically, the student may schedule a date for the defense, allowing a minimum of three weeks for the dissertation to be read. When the student has finalized a date he/she must inform the graduate assistant within three weeks of the date so that the Graduate Program Coordinator can prepare the proper paperwork and post notices of the defense to the University community. Communicating confirmation of the date and meeting place to each committee member is the responsibility of the student. If any of the original committee members are unavailable, the Graduate Group Chair will appoint replacements as needed. Upon agreeing to an examination date, the committee members guarantee to complete an initial review of the dissertation at least One week prior to the scheduled exam date. During that week, they should be available for consultation with the student to discuss possible necessary dissertation revisions and deficiencies prior to the examination. The responsibility for initiating contact rests with the student, but an equal responsibility rests with the dissertation committee to make the student and advisor aware of problems prior to the examination. In extreme cases, the committee chair may act to postpone the examination date if in his/her judgment the dissertation is not ready for defense.

## **3. Final Examination**

The actual final examination consists of a defense of the dissertation by the student. It is conducted in two parts:

1) A public defense, in which the student orally presents the results of his/her research as a public seminar of 30-40 minutes duration, followed by an open question period. The entire University community is invited, with suitable announcements distributed as with regular departmental seminars.

2) Immediately following the open defense, there is a closed examination, open only to the dissertation committee. If he/she deems it advisable, the dissertation committee chair may invite additional persons to the closed examination. Such persons may participate in the examination but do not take part in the final vote.

At the conclusion of the final examination, the committee decides by majority vote, as to whether the student passes the final examination and whether the dissertation is acceptable. The results are transmitted to the Graduate Group Chair, who has primary responsibility for acceptance of the dissertation as representative of the entire Graduate Group Committee. It is expected that in all but the rarest circumstance the Graduate Group Chair will consent to the committee's recommendation, and will break a tie vote if necessary the Graduate Group Chair can overrule the dissertation committee. In order to overrule the dissertation committee, the Graduate Group Chair must submit a written opinion to the entire Graduate Group Committee, who then take final action.

If the student is judged to have passed the final examination, but the dissertation is deemed to require revision, the review committee shall determine what revisions are necessary, and the basis for further review. Such revisions will be specified in a letter from the Examining Committee Chair sent to the candidate and his/her advisor within 48 hours of the examination. The dissertation committee chair is responsible for overseeing this aspect of the review and for certifying to the Graduate Group Chair that the dissertation is finally acceptable. The student must then submit sufficient copies of the approved dissertation for each of the committee members, if they require them.

#### **4. Submission of Dissertation to Vice Provost**

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The Office of Academic Programs will post the deadline dates for depositing the completed dissertation at the Office of the Vice Provost of Graduate Education (16 College Hall), at the beginning of each semester. Adhere strictly to these deadlines to avoid disappointment.

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The student will call *(215) 898-5720* to make an appointment with the office of the Vice Provost for Graduate Education to submit the dissertation. Also to be included with the official copies are an Abstract not to exceed 350 words, as required for submission to Dissertation Abstracts. (Details on particulars can be found in the current Doctoral Dissertation Manual). The student must inform the Graduate Program Coordinator of the

date and time of the appointment at least one week in advance in order for the assistant to complete the Degree Certification (Form 152) and Dissertation Certification (Form 153) forms which must be taken to 16 College Hall along with the dissertation copies. It is the responsibility of the student to get original signatures of the student's advisor and Graduate Group Chair on the title pages. Each student should obtain the signature of their advisor on the title page before meeting with the Graduate Group Chair for approval and signature on the title page.

After the office of the Vice Provost for Graduate Education has accepted the dissertation, (3401 Walnut Street, Suite 322A) at least two unbound copies must be provided to the Bioengineering office for binding at the department's expense (one is the department's copy and one is for presentation to the student's advisor). The department may have additional copies bound at the student's request and expense, and will collect payment from the student at the time the request is made.

University of Pennsylvania Doctoral Dissertation Manual can be found at:  
[http://www.upenn.edu/provost/dissertation\\_manual](http://www.upenn.edu/provost/dissertation_manual)

## **Graduation**

Since all Ph.D. candidates at the University of Pennsylvania are governed by procedures established in the SAS Graduate Office, Engineering Ph.D. candidates should be aware that their applications for graduation are processed in the SAS Graduate Office and that their dissertation is submitted there. The SAS Graduate Office firmly observes the deadlines they establish, so it is important to adhere to their requirements.

Early application for graduation is necessary to ensure that grades, dissertation preparation and/or revisions, and financial obligations can be fulfilled by the deadline for graduation. Also, the process for ordering and printing diplomas can take up to three months.

Candidates for Ph.D. degrees need to apply online:

[http://www.sas.upenn.edu/GAS/home/grad&beyond/degree\\_index.html](http://www.sas.upenn.edu/GAS/home/grad&beyond/degree_index.html)

### **GRADUATION CHECK LIST:**

- 1) Obtain dissertation instructions from 111 Towne Building at:  
[http://www.upenn.edu/provost/dissertation\\_manual](http://www.upenn.edu/provost/dissertation_manual), early in the writing stage.
- 2) Confer with your adviser and inform him or her of the need for a timely reading and signature before graduation.
- 3) Fill out the application form well in advance of the deadline.
- 4) Make sure that your financial obligations are cleared before the end of the final semester.
- 5) Check that your academic record is complete, and that appropriate courses have been taken for the degree. Students who have completed all requirements for the degree before

their final semester should obtain an exemption from registration form in 111 Towne Building.

6) Order cap and gown from the Bookstore in early March if you wish to participate in the May graduation ceremony. May is the only formal graduation ceremony. (Students who graduate in August or December of the preceding year are invited to attend the May ceremony. Students anticipating graduation in the same year may request, by approval, to participate in the May ceremony.)

## **Records**

The official graduate student records are kept in 111 Towne Building and transcripts can be viewed through Penn In Touch. Graduate students are encouraged to periodically check transcripts. Look for unreported grades or other discrepancies. Please bring any questions or concerns about your transcripts to the attention of the Bioengineering Graduate Program Coordinator in 240 Skirkanich Hall.

## **Financial Support**

Financial support for all PhD students is made available through a number of sources such as funds from the School, the Department, research grants of the faculty, and industrial sources, as well as from federal and foundation fellowships granted to the student. A given faculty member plays the primary role in selecting a student for a research fellowship supported by his/her grant. The Graduate Group Chair formally makes all fellowship appointments. Full-time students are expected to work full time on research in the summer months. Should a dissertation advisor be unable to provide funding for a student's stipend and tuition the Graduate Group Chair will work with the student to find another advisor to mentor the student, possibly associated with a change in research topic.

We encourage all students to apply for graduate training fellowships during their graduate studies. Some students apply for fellowships prior to matriculating to Penn and these fellowships provide students tremendous flexibility in choosing a lab for their research.

Any PhD student who is awarded an extramural individual fellowship may qualify for a one-time \$3,000 bonus in addition to their standard stipend.

Some of the most common sources for fellowships and PhD training support are provided at:<http://www.be.seas.upenn.edu/prospective-students/doctoral/financial-aid.php>. Proposal writing workshops are offered by the School annually.

