UNIVERSITY of PENNSYLVANIA

Ph.D. PROGRAM

GUIDELINES FOR GRADUATE STUDY

August 2026

Mechanical Engineering and Applied Mechanics
School of Engineering and Applied Science
University of Pennsylvania
229 Towne Bldg., 220 S. 33rd Street
Philadelphia, PA 19104-6315
meam@seas.upenn.edu
www.me.upenn.edu
Tel. 215-573-9959

TABLE OF CONTENTS

1. Introduction… 3

2. Administrative Structure 3

3. Advisors…..…. 3

4. General Information 3

    Course Selection Approval 3
    Typical Course Load 3
    Registration, Leaves of Absence 4
    Changes in Course Program 4
    Grades, Credits, and Academic Standing 4
    Academic Integrity 4
    Employment 4

5. Degree Requirements 4

6. Policy on Transfer of Credit Units Earned in Other Institutions 6

7. Independent Study 6

8. Teaching Practicum 7

9. Obsoleteness… 7

10. The MEAM Ph.D. Qualifying Examination Policy 7

11. The Direct Path to the Ph.D. for Students Without an M.S.E. Degree 9

12. Obtaining an M.S.E. Degree 9

13. Dissertation.. 9

14. Seminar Presentation Requirement 11

15. Attendance at Departmental Seminars and Thesis Presentations 12

16. Summer Studies 12

17. Records ……13

18. Grievances 13

19. Financial Support 13

20. The Graduate Environment 14

Appendix A: Sample 1st year Ph.D. Program and Course Planning Form 14

Appendix B: Time Line for Ph.D. Students 15

1. INTRODUCTION

This document, also available at www.me.upenn.edu/current-students/doctoral/handbook.php, describes the guidelines for the Ph.D. program in Mechanical Engineering and Applied Mechanics (MEAM). Additional information is available on the School of Engineering and Applied Science (SEAS) website: www.seas.upenn.edu/graduate/handbook. It is the student's responsibility to be familiar with the rules, procedures, and requirements of MEAM, SEAS, and the University of Pennsylvania. Advice and additional information may be obtained from your advisor, the Graduate Program Coordinator,[2] or the MEAM Graduate Group Chair.[1]

Students who matriculated before August 2026 are subject to the policies that were in effect as of their matriculation date.

2. ADMINISTRATIVE STRUCTURE

The graduate program in MEAM is administered by the MEAM Graduate Group. The MEAM Graduate Group is comprised of the primary faculty members of MEAM 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 mechanical engineering. The current members of the MEAM graduate group and their research areas can be obtained from the website: https://www.me.upenn.edu/research/graduate-group/. Additional information can be obtained from the department website.

All graduate programs in SEAS are administered under the auspices of the Office of Research and Academic Services, whose activities with respect to graduate studies in MEAM are in conjunction with the recommendations of the MEAM Graduate Group Chair[1].

3. ADVISORS

An advisor is appointed for each Ph.D. student by the MEAM Graduate Group Chair. The advisor works with the student to develop an appropriate program of study and must approve of the student's course plan. The advisor also serves as a research mentor and monitors the student's progress on dissertation research.

4. GENERAL INFORMATION

The objective of the doctoral program is to educate a cadre of highly competent researchers who will pursue careers in academia, research, and technological leadership. The centerpiece of the doctoral program is dissertation research. Ph.D. students are expected to spend most of their time and energy generating high quality, original research. The courses taken during a student's tenure at the University will be geared towards providing the necessary background to conduct quality research and to strengthen the student's foundational knowledge in mechanical engineering. Each student's professional reputation and, to some extent, that of the Department, depend on success in generating a high-quality dissertation. Furthermore, the research grants that faculty receive and all other funding available in the Department for graduate students are closely tied to the department's research productivity.

Course Selection Approval

Graduate students in MEAM have a wide variety of interests, and the MEAM 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. The student must obtain their advisor's approval for any course selection. A sample first year course plan for MEAM doctoral students is available in Appendix A.

Typical Course Load

All students enrolled in a degree program are required to be continuously registered. Three courses per semester (including independent study or dissertation research courses) is a normal, full-time load for all doctoral students. Students must consult with the MEAM 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.

[1]Dr. Jordan R. Raney, Room 274, Towne Bldg. (Tel. 215-573-9928, email: raney@engineering.upenn.edu)
[2]Peter Litt, Room 229, Towne Bldg. (Tel. 215-573-9959, email: peterlit@engineering.upenn.edu)

Registration, Leave of Absence
Continuous registration is required for all graduate students, unless a formal leave of absence is granted by the Dean of the student's school. A student who has reached dissertation tuition status will not be granted a leave of absence, except for military duty, medical reasons, or in cases where the student receives a grant for dissertation research conducted abroad and the grant does not include funds to pay home institutional fees. A student not in dissertation status, who desires a leave of absence, must submit a request to the MEAM Graduate Group Chair and to the Office of Academic Services.

Changes in Course Program
Students may add or drop courses without penalty in any semester if it is done by the deadline listed in the current graduate bulletin. The student must inform the advisor of the decision beforehand and receive their approval. However, international students must maintain full-time status in accordance with the rules administered by International Student and Scholar Services (ISSS).

Grades, Credits, and Academic Standing
The grading system is as follows: A+ (4.0) Excellent/Outstanding; A (4.0), Excellent; B (3.0), Good; C (2.0), Fair; D (1.0), Below Average; F (0.0), Failure; and (I) Incomplete. A course in which an F was obtained must be taken again; however, the F remains on the student's record. In accordance with SEAS policy, "No grade lower than a 'C-' will be counted in courses designated as 'core' courses or those courses must be retaken." Courses for which a passing grade was obtained cannot be retaken 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. Requirements cannot be satisfied by auditing courses or receiving an incomplete (I) grade.

Academic Integrity
Each MEAM student is expected to abide by Penn's Code of Academic Integrity. All academic work that students perform should be an accurate reflection of their own understanding and effort. Moreover, students should not knowingly use any dishonest method to gain an unfair advantage over other students in academic pursuits. Violations of these policies include, but not limited to:

- Giving or receiving any unauthorized aid on an assignment or exam, including working in groups on any assignment that has been designated as individual by the professor;
- Misrepresenting the originality of one's work (plagiarism), particularly through direct copying of work and also through failing to note the contributions of others, except as permitted by the instructor;
- Misrepresenting one's own understanding or effort via inappropriate use of large language models or other AI-based tools;
- Submitting substantially the same work for credit in more than one class, except with prior approval of the instructor.

If there is any doubt as to what is permissible, it is the student's responsibility to ask the instructor. Students who violate the Code of Academic Integrity will be subject to disciplinary action, which may include referral to the Office of Student Conduct. For more information, please see the Student Guide on Academic Integrity: https://catalog.upenn.edu/pennbook/code-of-academic-integrity/.

Employment
PhD students who are supported by a fellowship are expected to be engaged in their studies and research full time. Accordingly, accepting employment above the fellowship requires specific approval that must be obtained **prior** to accepting such employment. Students who are contemplating employment should speak to their advisor and then contact the Graduate Program Coordinator to obtain information on the current approval process.

5. DEGREE REQUIREMENTS

Detailed regulations and requirements concerning the degree are described in the current Graduate Student Handbook (www.seas.upenn.edu/graduate/handbook/index.php). 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 Ph.D. requirements include the completion of graduate level work beyond the undergraduate degree with a grade-point average of at least 3.0 at the end of every semester, satisfactory performance in the Ph.D. qualifying and dissertation proposal exams, presentation of a departmental seminar, completion of two semesters of teaching practicum (MEAM 8950), and the submission and successful defense of an original and significant dissertation. Students not making satisfactory academic progress may receive a warning or be placed on academic probation. If a student receives a warning or is placed on probation, the student should immediately schedule an appointment with the Graduate Group Chair to formalize a plan of action. In the absence of improvement in the subsequent semester, students on warning or probation may be dropped from their program. Each course is worth one course unit, with the exception of research (MEAM 9999) and qualifying exam (MEAM 8990) courses, which can range from 1 to 4 course units on approval of the advisor. The milestones in the Ph.D. program are noted in Appendix B and described in detail in this document.

Course requirements for MEAM PhD students:

- Two core mathematics courses listed below:
  - ENM 5200 Principles and Techniques of Applied Mathematics I*
  - One course selected from this list:
    - ENM 5210 Principles and Techniques of Applied Mathematics II*
    - ENM 5220 Numerical Methods for PDEs
    - ENM 5310 Data-driven Modeling and Probabilistic Scientific Computing
    - MATH 5000 Topology
    - ESE 5000 Linear Systems Theory
    - ESE 6050 Modern Convex Optimization
- Three core MEAM courses chosen from the list of six courses below:
  - MEAM 5190 Elasticity and Micromechanics of Materials
  - MEAM 5300 Continuum Mechanics
  - MEAM 5350 Advanced Dynamics
  - MEAM 5610 Thermodynamics: Foundations, Energy, Materials
  - MEAM 5700 Transport Processes I
  - MEAM 6200 Advanced Robotics
- Three additional graduate courses related to the student's research
- Two semesters of Teaching Practicum (MEAM 8950; normally taken in year 2 and year 3)
- Six semesters of the MEAM seminar (MEAM 6990)
- Responsible Conduct of Research in Engineering (EAS 9000; mandatory in the first year)

Notes:

- Neither MEAM 8990 (Qualifying Exam) nor MEAM 9999 (Research) can be used to satisfy the above course requirements.

* Students should check their preparedness for ENM 5200 and ENM 5210 by reviewing the syllabi before registering for these courses. If this material is unfamiliar, the student should take ENM 5100 prior to taking ENM 5200 or ENM 5210.

Requirements on the timing of courses for MEAM PhD students:

- A minimum of 4 graduate-level courses must be taken in year 1.
  - At minimum, these 4 courses should include:
    - 1 core math course and 1 core MEAM course
      OR
    - 2 core MEAM courses
  - All courses taken to satisfy the 4-course requirement in year 1 should be MEAM, ENM, or other research-relevant courses
- A minimum of two core MEAM courses must be completed by the end of year 2
- All core MEAM courses and the core math courses must be completed by the end of year 3

The above timing is the minimum requirement. The faculty of the Graduate Group strongly recommends that students take two MEAM core courses related to their research in year 1 and the third MEAM core course in year 2. Furthermore, the faculty strongly recommends that the core math courses be taken during year 1 and year 2. Appendix A shows a sample course plan for 1st year students.

6. POLICY ON TRANSFER OF CREDIT UNITS EARNED AT OTHER INSTITUTIONS

A maximum of nine graduate-level course units taken at another university may be accepted for transfer credit. **To be eligible for transfer credit, a course must have been taken within the five (5) years prior to requesting transfer credit at Penn and a letter grade of B or above must have been received in the course.** Per University policy, graduate courses taken when a student was an undergraduate will not be considered for graduate transfer credit. Additionally, study abroad courses, online courses, courses without a letter grade, and courses taken in a non-degree certificate program will not be considered for transfer credit. Transfer credit is subject to approval by the MEAM Graduate Group Chair and the Associate Dean for Academic Affairs in accordance with the rules of the University at the time of the student's matriculation. Students who wish to receive such credit must submit a petition to the MEAM Graduate Group Chair (https://grad.seas.upenn.edu/student-handbook/academic-options/). To obtain credit for courses taken at other institutions the following steps must be taken:

- For each transfer course, obtain the course description and the title of the textbook prescribed for the course.
- Identify a professor who teaches a similar course at Penn. If a similar course is not offered at Penn, identify a professor whose areas of expertise are in the general area of the course to be transferred. The professor should certify that the course is of similar level to a graduate course offered at Penn or, if a similar course is not offered at Penn, that the course qualifies for Penn students to take if it were offered here.
- Submit a petition on a standard form (https://grad.engineering.upenn.edu/wp-content/uploads/2025/02/g-transfer-credit-updated-February-2025.pdf) to the MEAM Graduate Group Chair. Attach to the petition a copy of the transcript, the professor's certification, and documents and information noted in the transfer credit form.

7. INDEPENDENT STUDY

Independent study courses are important vehicles to accommodate special interests of the students that are not served through the regular courses. They create opportunities for mini-projects and a mentoring relationship between students and faculty. Independent study also can serve as a means for students and faculty to lay a potential foundation for dissertation work prior to making a long-term commitment. The student should identify the topic and scope of the independent study in the semester prior to the one in which they intend to take the independent study, and should identify a faculty advisor whose interests and expertise match the independent study topic.

Since independent studies are less structured than regular courses and typically do not come with strict deadlines, occasionally students tend to fall behind in their work. There is also the possibility of miscommunication between the student and the faculty on the objectives, extent, scope, and the grading method for the independent study.

The purpose of this policy is to set the rules for an independent study with the objectives of maintaining academic rigor and minimizing any potential for a miscommunication.

- An independent study course should require an effort comparable to that of a regular course, about 10 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 can lead to a less than satisfactory performance in the independent study course. 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.
- Prior to the beginning of the semester in which the student contemplates taking the independent study, the student and their advisor should develop an independent study proposal. The first paragraph of the proposal should describe the objectives, scope, and content of the independent study. The second paragraph should state how the independent study will be evaluated and how the student will be graded. The document should be signed by both the student and their advisor, and it should be submitted to the MEAM Graduate Group Chair for approval before the beginning 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, which objectives were met, and which 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 will

be included in 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's not receiving credit for the independent study.

8. TEACHING PRACTICUM

Participation of graduate students in the teaching mission of the department helps to develop teaching, presentation, leadership, and interpersonal skills. All doctoral students are required to complete two semesters of teaching practicum (MEAM 8950). MEAM 8950 is an 0.5 course unit class that requires the equivalent of 10 hours of effort per week for one semester. In fulfillment of the teaching practicum requirement, students will perform several of the following duties under faculty guidance, as appropriate: attend seminars on teaching and communication skills, lead recitations, lead tutorials, supervise laboratory experiments, develop instructional laboratories, develop instructional materials, and grade homeworks, laboratory reports, and exams. A teaching training workshop, offered by the Center for Teaching and Learning, is conducted during the summer (typically August) prior to the fall semester. Attendance is mandatory for all second-year students. To the extent possible, students will participate in a broad range of teaching activities beyond grading. Some of the recitations will be supervised, and feedback and comments will be provided to the student by the faculty responsible for the course. At the completion of 0.5 course unit of teaching practicum, the student will receive a Satisfactory/Unsatisfactory grade and a written evaluation signed by the faculty member responsible for the course. The evaluation will be based on comments of the students taking the course and the impressions of the faculty in charge. Students whose first language is not English are required to take and pass an English proficiency examination (the Interactive Proficiency Test, or IPT), or else provide proof of English ability in the form of a recent TOEFL, IELTS, or Duolingo English Test (DET). The IPT is offered by Penn English Language Programs and must be completed before the student begins the teaching practicum.

It is an unfortunate fact that cheating occasionally occurs in classes taught at Penn. Teaching assistants are often the first to notice questionable behavior among students that might be construed as cheating. It is the responsibility of the teaching assistant to understand what is permissible and what is considered cheating for each of their three teaching practicum classes.

Teaching assistants who see what appears to be cheating in progress, for example during an exam, should take the following steps:

- Interrupt the impermissible conduct and immediately and quietly remove or confiscate notes or other materials a student is using. It is important that the notes be saved as potential evidence
- Ask that students move apart/change seats
- Reiterate the expectations and rules on examination-taking for the class
- Permit a student to complete an examination, even if cheating is suspected
- After the exam is over, set the completed examinations aside and record names of nearby students, in case it is necessary to contact witnesses later
- Tell the faculty member in charge of the class about the suspected cheating incident

Teaching assistants who suspect cheating after the fact, for example identical homeworks submitted by two or more students, should consult with the faculty member in charge of the class.

Helpful information on how to discourage cheating may be found in the Code of Academic Integrity: http://www.upenn.edu/academicintegrity/.

9. OBSOLETENESS

The Ph.D. program, culminating in a successful defense of the doctoral dissertation, must be completed within a period of ten years from the year of matriculation as a graduate student in the School of Engineering and Applied Science of the University of Pennsylvania.

10. THE MEAM Ph.D. QUALIFYING EXAMINATION POLICY

All students who are working toward the Ph.D. degree must take and pass the Ph.D. Qualifying Examination. This examination serves to determine a student's ability to independently conduct research of high quality.

The qualifying examination is administered in the following manner:

1. By the end of the first semester, each full-time doctoral student will elect an independent study in the general area in which they wish to pursue dissertation research. The independent study will be carried out during the second semester, and it will be mentored by a willing faculty advisor chosen by the student. The advisor must be a member of the MEAM Graduate Group. While the advisor need not be the student's Ph.D. dissertation advisor, it is recommended that students choose a faculty advisor who is likely to serve as their dissertation supervisor in the future.

2. The independent study course taken for the qualifying exam will follow the basic guidelines outlined in Section 7, with the additional condition that the independent study be research oriented. A research oriented independent study can consist of a critical review of a body of literature, a new contribution to address gaps in the existing literature, a formulation and possibly a solution of a new mathematical model, an experimental study, or a combination of the above. The independent study should afford the student the opportunity to carry out independent research.

3. The student will submit an independent study proposal to the Graduate Coordinator, who will convey it to the MEAM Graduate Group Chair. The proposal is due the Wednesday one week after the start of spring semester classes. The specific due date will be announced toward the end of the fall semester. Students should work closely with their advisor in developing their independent study proposals and the advisor should review and approve the proposal prior to submission. The independent study proposal should be brief (typically one page or less) and must be signed (or approved via e-mail) by the student and the advisor. It should be written in a way that is comprehensible to individuals other than the student and their advisor. The proposal should be structured as follows:

   (a) Page 1 should be a cover page stating the title of the independent study, the student's name, and the student's Ph.D. advisor.

   (b) Page 2 should contain the following:

   - First paragraph: a brief summary of the motivation, objectives, scope, and anticipated content of the independent study proposal. The aim of this paragraph is to answer the following questions: What problem/topic do you plan to address in the independent study? Why is the chosen topic interesting or important? What do you hope to achieve/complete in the semester long project (be as specific as possible)? What approaches, methods, tools, etc. do you plan to use? A list of pertinent references should be provided at the end of the proposal.

   - Second paragraph: a statement describing the anticipated outcomes of the independent study and how the independent study will be evaluated.

   - Third paragraph: a summary of foundational topics that underpin the proposed independent study. Briefly describe which foundational subjects/topics in mechanical engineering, math, and/or related engineering disciplines are central in the proposed independent study. This summary should also list courses (undergraduate and/or graduate) that the student will use knowledge from to complete the independent study.

4. At the beginning of the second semester, the MEAM Graduate Group Chair will appoint a Qualifying Examination Committee for each student. The Committee will include the student's advisor, a committee chair, and a math examiner. At least half of the committee members, including the committee chair and the advisor, must be members of the MEAM Graduate Group. The math examiner's responsibility is to ensure that the student has a fair knowledge of undergraduate mathematics as contained in the syllabi of MATH 1400, MATH 1410, ESE / ENM 2030, and ENM 2510. The student is also expected to know the concepts taught in all graduate math courses (such as ENM 5100, 5200, 5210) that they have taken before the qualifying exam. The Committee will be chosen based on the area of the student's independent study. To obtain feedback on research progress, the student may choose to make a mid-semester brief oral presentation to the Committee or, if it is convenient to do so, at the group meeting of a faculty member different from their advisor.

5. On or before the last day of final examinations in the student's second semester, the student will submit a report to their Qualifying Exam Committee that summarizes their independent study work. The report should be submitted electronically. If some committee members prefer a hard copy of the report, the student will provide one to them upon request. The cover page of this report should include the independent study title, student's name, name and roles of all committee members, and the time, date, and location of the Qualifying Exam. The student will also submit an electronic

version of the report to the Graduate Coordinator, who will convey it to the MEAM Graduate Group Chair. The report should be written in the format of a journal paper (approximately 20 pages, double spaced), and it should be understandable by an educated audience not expert in the field. The due date of the reports will not be extended. The student will receive a grade for the qualifying exam (MEAM 8990) given by the faculty advisor. This grade will be based on the student's written qualifying exam report and their work over the course of the semester. The MEAM 8990 grade will be independent of the outcome of the qualification process.

6. No later than a month after the last day of finals, the student will take the qualifying examination. Only students in good academic standing who have no I (incomplete), U (unsatisfactory), or F (failing) grades on their transcript will be allowed to take the examination. "Good academic standing" implies that the student's cumulative grade point average, including both fall and spring semesters except the qualifying exam courses (MEAM 8990), is 3.0 or above at the end of the second semester in the MEAM Ph.D. program. Students who are not in good academic standing cannot take the qualifying examination and must leave the Ph.D. program. In the examination, the student will present their report to the Committee and respond to questions orally or, if directed by the committee, by writing on the board. The presentation itself should be approximately 30 minutes in length. The Committee may ask additional questions related more broadly to the independent study and on material covered in the student's courses (including mathematics courses). The math examiner (and any other committee members) may ask questions on mathematics relevant to the broad area of the independent study.

7. The Qualifying Exam Committee will review the student's record in coursework, their independent study report, and their performance in the oral examination. Then, the committee chair, in consultation with other members of the committee, will make a recommendation to the MEAM Graduate Group Chair on the outcome of the qualifying examination. The Committee may also suggest a course plan or make other recommendations to help the student deal with any weaknesses in their background. In exceptional cases, the Committee may recommend the submission of a revised paper and/or another presentation. The deadline for this revised paper/presentation will be determined by the MEAM Graduate Group Chair in consultation with the Committee, but must be no later than two months after the last day of final examinations in the spring semester. The Graduate Group will make the final decision as to whether the student passes the exam. The MEAM Graduate Group Chair will inform the student about the result and if applicable, will specify the deadline for any revised papers, presentations or other recommendations. If the deadlines stated here are not adhered to, an explanatory letter signed by the student and the advisor must be submitted to the MEAM Graduate Group Chair for approval.

Scheduling of the qualifying exams will be coordinated by the Graduate Group. It is the student's responsibility to remind their committee members of the time and place of the Qualifying Exam at least one week before the scheduled exam.

11. THE DIRECT PATH TO THE Ph.D. FOR STUDENTS WITHOUT AN M.S.E. DEGREE

Students who have only a bachelor's degree and wish to study for the Ph.D. are encouraged to register as Ph.D. students. However, they may obtain a Master's degree if they so desire during their Ph.D. program. The students must inform the MEAM Graduate Coordinator of their intent with respect to the Master's degree.

12. OBTAINING AN M.S.E. DEGREE

The master and doctoral programs have different objectives. An M.S.E. degree will not be automatically granted to a Ph.D. student upon the completion of 10 course units. Doctoral students who desire to obtain an M.S.E. degree at some point along their doctoral studies must petition the MEAM Master's Chair[1]. In order for courses to count toward the Master's degree, the student must inform the Graduate Coordinator at the end of each term. The Graduate Group or its designee will review the petitioner's records and determine whether the granting of the M.S.E. degree is appropriate. Typically, M.S.E. degrees are awarded to Ph.D. students at the end of their third year at Penn.

13. DISSERTATION

Several recognized paths are available to the student when choosing a dissertation topic. Often the topic will be the natural result of sponsored research the student may be working on. Sometimes a particularly challenging problem at the student's

[1] Dr. Howard H. Hu, Room 241, Towne Bldg. (Tel. 215-898-8504, email: hhu@engineering.upenn.edu)

place of employment will form the foundation for a dissertation. Regardless of the route by which a dissertation topic is chosen, a student must have a faculty member willing, by mutual agreement, to act as a dissertation advisor. It is essential that the student realize that the dissertation is the culmination of years of study and is the distinguishing feature of the Ph.D. degree. Clearly, dissertation topics and advisors should be chosen with care and deliberation. The student should feel free to discuss possible topics and dissertation supervision with any and all MEAM faculty members.

MEAM 9999 is the course number assigned to dissertation research. Several units of this course may be taken simultaneously. The grading of MEAM 9999 is done by the student's dissertation advisor. This course is letter grade (ABCDF).

Each Ph.D. student is required to have a Dissertation Committee in place by the end of their second year of study. The role of the Committee is to provide guidance and feedback to the student throughout their doctoral program. The Dissertation Committee is distinct from the Qualifying Exam Committee, whose purpose is to examine the student's readiness for Ph.D. research. The Dissertation Committee is composed of the advisor, a reader, and a Committee Chair. The advisor or co-advisor cannot serve as the committee chair or reader. The Committee Chair and advisor must be members of the MEAM Graduate Group and the Committee Chair must also be a member of the Standing Faculty at the University of Pennsylvania. Additional committee members may come from disciplines related to the student's research topic. The Committee may include members who are not on the faculty of the University of Pennsylvania as long as at least three members of the Committee are members of the Standing Faculty of the University of Pennsylvania. At least half of the Committee members must be members of the MEAM Graduate Group.

The following steps are required to appoint a Dissertation Committee:

- The Ph.D. student and the advisor discuss and agree upon which faculty would be suitable Committee members.
- The Ph.D. student contacts each prospective Committee member to determine whether they would be willing to serve on the Committee.
- Once all Committee members have agreed, the Ph.D. student e-mails the MEAM Graduate Group Chair (copying the advisor and the Graduate Program Coordinator) to request formal appointment of the selected faculty members to the Committee.
- If the MEAM Graduate Group Chair approves, the Committee will be appointed. The student and Committee will be notified upon approval. If approval is not granted, the MEAM Graduate Group Chair will work with the advisor and student to appoint an appropriate committee.

At a minimum, the Dissertation Committee must meet annually with the student to provide guidance and feedback.

Changes in a Ph.D. student's Dissertation Committee membership may sometimes be warranted, for example due to a change in the student's research direction, faculty sabbatical leave, or other occurrence. In such instances, the student should contact the MEAM Graduate Group Chair (copying the advisor and the Graduate Program Coordinator) to request approval of any proposed changes to the Committee.

The dissertation proposal is a document outlining the plan for the student's doctoral research. **A full-time Ph.D. student must prepare and orally present their dissertation proposal to the Dissertation Committee by the end of the third year of study.** Any extensions to the proposal deadline must be approved by the MEAM Graduate Group Chair. No dissertation proposal may be presented without prior approval of the Dissertation Committee by the MEAM Graduate Group Chair. At least two weeks before the dissertation proposal presentation, the student will submit an electronic copy of the proposal to their Dissertation Committee. If some committee members prefer a hard copy of the proposal, the student will provide one to them upon request. The student will also submit an electronic version of the proposal to the Graduate Coordinator, who will convey it to the MEAM Graduate Group Chair.

The proposal should include the following:

- A cover page indicating the date, time, and location of the dissertation proposal presentation.
- The main goal(s) of the dissertation.
- A discussion of previous related work in the field.
- An explanation of why the dissertation is a new contribution to the field.
- A breakdown of the major tasks that will be pursued to accomplish the goal(s).

- A discussion of work the student has already done.
- A discussion of how the remaining work will be performed (methods, approaches, resources, etc.).
- A timeline for completion of the major tasks and an estimated graduation date.

The intent of the proposal presentation is for the committee to assess whether the plan for the dissertation is novel, feasible, and possible to complete in the desired timeframe, and for the student to receive feedback and guidance on the proposed work. The committee often makes constructive suggestions for strengthening the research and the eventual dissertation. The Dissertation Committee Chair will inform the MEAM Graduate Group Chair and the student, in writing, on whether the Dissertation Committee has approved the proposal and what its recommendations are on further work. If the proposal is not approved by the Dissertation Committee, the student must make the necessary improvements, resubmit, present the new proposal, and earn its approval. The proposal must be completed at least six to twelve months prior to the final dissertation defense. A Ph.D. student is advanced to Ph.D. candidacy after successfully presenting the dissertation proposal.

To avoid any misunderstanding, it is emphasized that the dissertation itself is not approved at the dissertation proposal meeting; only the area of the research topic and a general plan of the dissertation are approved.

Any significant changes to the proposed research after the proposal must be presented to and approved by the Committee.

When the dissertation advisor is satisfied with the dissertation presented by the student, copies of the dissertation are given to the members of the Dissertation Committee for study and critique. Normally, the Dissertation Committee members require three or four weeks to examine a dissertation, and the student should recognize this when attempting to meet deadlines. Once all members of the Committee are satisfied with the dissertation, the student may then schedule the dissertation defense. If the Committee feels that major modifications are in order, the defense cannot be scheduled until such modifications are made to the Committee's satisfaction.

The dissertation defense by the doctoral candidate is given at a meeting open to the public. The announcement of the defense to the public must be submitted to the Graduate and Seminar Coordinators for posting at least three weeks prior to the presentation. After the presentation by the candidate, the Dissertation Committee will ask questions on several aspects of the work. Additional questions or comments from others attending the presentation will then be solicited. The general public will then be asked to leave the room prior to a final session at which more questions may be asked by the Dissertation Committee. The Dissertation Committee will decide on acceptance or the non-acceptance of the dissertation at the conclusion of this meeting.

Once the dissertation has been accepted by the Dissertation Committee, the student will submit the final version of the thesis with the advisor's signature for the approval of the MEAM Graduate Group Chair. The student will submit the thesis to the MEAM Graduate Group Chair at least two weeks prior to the university's deadline for Ph.D. theses. After examining the thesis, the MEAM Graduate Group Chair may either approve and sign the thesis or return the thesis to the student requesting additional modifications.

It is noted and emphasized that the dissertation must be prepared and submitted in accordance with the rules and schedules of the School of Engineering and Applied Science of the University of Pennsylvania. The format is explained in the booklet "Doctoral Dissertation Manual" available at http://guides.library.upenn.edu/dissertation_manual. Failure to follow the above schedule and requirements will result in a delay in awarding the degree.

All dissertations must be freely publishable and the contents cannot be restricted from dissemination to the community at large by the candidate's place of employment or the sponsoring agency, the government, or any person. In those rare cases where data or results are partly or fully proprietary, an embargo of six months or a year may be considered, but the results must ultimately be published. Any computer source code which constitutes a portion of the thesis (except for readily-available commercial software) must be available to the community at large. It is the responsibility of the student to ensure that the above requirements are duly considered in the planning and execution of the research program and in the presentation of the final document.

14. SEMINAR PRESENTATION REQUIREMENT

As a part of their degree requirements, all doctoral students must present a departmental seminar on their research prior to their dissertation defense. This seminar must be given at least one semester before the anticipated graduation date. Typically, the seminar is presented no later than the end of the fourth year after matriculation.

The Ph.D. seminar requirement serves the following purposes:

- The seminar gives the student an opportunity to practice presenting technical material and "thinking on their feet" while responding to questions from the audience. Similar seminars are often required by prospective employers both in academia and industry as a part of the interviewing process.
- The seminars help inform other students and faculty about ongoing research. These should be of particular interest to first year graduate students who are trying to identify relevant research areas.
- The seminars may help foster intellectual interactions in the department and the formation of a scholarly community. Comments and questions during the presentation may provide constructive suggestions to the presenter regarding how to improve their thesis while there is still time to do so.
- The presenters may include in their CV the fact that they have given a seminar at Penn.

No Ph.D. student will be able to graduate without fulfilling the Ph.D. seminar requirement. Ph.D. seminars are scheduled during the summer at the usual MEAM seminar time and receive public notice similar to that of other departmental seminars. It is the responsibility of the student to schedule a date for their seminar with the Graduate and Seminar Coordinators for a time when their advisor is available. Ph.D. students who wish to give a talk during any given summer will need to fix the date at least a month prior to the beginning of the summer.

The presenter should prepare their seminar carefully, keeping in mind that they will be talking to an intelligent audience with diverse backgrounds, some of whom may not be familiar with the speaker's specific research area. The student should have their advisor(s) critique the visuals and the presentation before the public presentation. A good introduction that gives background information, context, and motivation is a good idea. To allow ample time for discussion, the talk should not exceed 40 minutes. The presenter should anticipate and be ready to answer questions from the audience. During the discussion period, in order to encourage student questions, students in the audience will have be given a chance to ask questions before the faculty members do so. After the presentation, the student's advisor provides the student with feedback including comments on both strengths and areas for possible improvement. The presentation may be videotaped to give the student an opportunity to see themselves the same way the audience saw them.

15. ATTENDANCE AT DEPARTMENTAL SEMINARS AND THESIS DEFENSES

Full-time Ph.D. students are required to attend departmental seminars for a total of six semesters. There are many good reasons why students should attend departmental seminars even when the seminars are not directly linked to their area of research. For example:

- The seminar provides an opportunity to learn about the state-of-the-art in Mechanical Engineering and Applied Mechanics.
- The seminar provides an opportunity for the student to get acquainted with people from other institutions and companies and get a birds-eye view of the culture at other institutions. On more than one occasion, during job interviews, interviewers have been known to mention a visit to Penn and delivering a seminar. The student would like to be in a position to comment on that particular seminar and state how enjoyable it was.
- The seminar provides an opportunity for students to learn about research done by their fellow Ph.D. students.
- The departmental seminars are one of the few opportunities there are to get together as a department. It is hoped that a full attendance at these seminars will help create departmental spirit and cohesiveness.

Seminar course

The seminar course (MEAM 6990) has been established so that students get recognition for their seminar attendance and get a chance to develop their critical thinking skills. There are no exams in this course. The course is graded S/U. To obtain a satisfactory (S) grade, the student must attend more than 70% of the departmental seminars and complete mini-essay quizzes on three seminars of their choice. For example, in a term in which 12 seminars are given, the student will need to attend at least 9 seminars and complete three mini-essay quizzes to obtain a satisfactory grade. Attendance at a MEAM Ph.D. dissertation defense or MEAM M.S.E. thesis defense can be substituted for attendance at a seminar. Up to two of the seminars to be counted toward the MEAM 6990 requirement may come from outside MEAM. To be counted, a non-MEAM seminar must be part of an established Penn seminar series that is focused on

engineering, science, mathematics, computation, or other technical discipline. A mini-essay quiz must be completed for each non-MEAM seminar. Participation in the seminar course will be documented and recorded in the student's transcript. To obtain their degree, doctoral candidates must accumulate six credits of MEAM 6990. Students are encouraged to complete their seminar requirement in the first few years of Ph.D. study. Part-time students are exempted from the seminar attendance requirement although they are encouraged to attend the seminars.

16. SUMMER STUDIES

There are several possibilities for scholarly activities by graduate students at the University during the summer which include:

- Independent study and research (MEAM 8990 or 9999) with an instructor willing to act as a supervisor during the summer.
- Course work outside SEAS, as well as a limited number of regular courses occasionally offered by some SEAS departments. The advisor, in consultation with the MEAM Graduate Group Chair, must approve summer school courses.

Full-time students supported by research grants are expected to be in residence for the summer. Students who wish to take summer courses must obtain approval from their faculty advisor prior to registration. Questions on summer session registration should be referred to the Graduate Coordinator.

17. RECORDS

The official graduate student records are kept in 111 Towne Building and transcripts can be viewed on Path@Penn. Graduate students are encouraged to periodically check the accuracy of their records and to bring any discrepancies to the attention of the MEAM Graduate Group Chair.

18. GRIEVANCES

Students with grievances should contact the people below, in the following suggested order:

a. Graduate Group Chair;
b. Department Chair;
c. Associate Dean for Graduate Programs;
d. University Ombuds;

In case of conflicts of interest, then the next non-conflicted level should be engaged. At any point the student may wish to circumvent steps a-c and contact the University Ombuds. More information on University and SEAS grievance procedures may be found here:

- University of Pennsylvania Student Grievance Procedures
- SEAS Grievance Procedures Guidelines (Section E)

19. FINANCIAL SUPPORT

Financial support for graduate students is made available through a number of sources such as funds from SEAS, funds from MEAM, research grants of the faculty, and industrial sources, where research support is predominant among all. A given faculty member plays the primary role in selecting a student for a research fellowship supported by their grant. Appropriate committees will choose students for other scholarships and internal fellowships. The MEAM Graduate Group Chair formally makes all fellowship appointments. Most sources of funding, research grants in particular, include support for the summer months. Students are expected to work full time on research in the summer months during which they are supported.

Ph.D. students who obtain external merit based competitive fellowships that provide substantial coverage of tuition and fees, including NSF, DOD, DOE, and NIH fellowships, will be awarded a one-time stipend supplement of $3,000 in the

first year (NSF IGERT fellowships excluded).

20. THE GRADUATE ENVIRONMENT

The size of the Department of Mechanical Engineering and Applied Mechanics fosters a close interaction between the graduate students and the entire faculty. This enhances the quality of student-faculty communications and enriches the academic environment to benefit both learning and discovery.

Apart from offering advising, seminars and meetings to introduce incoming students to faculty research, and informal meetings with the Department Chair and MEAM Graduate Group Chair to solicit student input and exchange information, the Department strongly supports the Mechanical Engineering Graduate Association (MEGA). MEGA is a student-run association that represents the entire graduate student community in MEAM, and organizes both social and technical events. A chosen representative of MEGA will be invited, if appropriate, to attend Graduate Group meetings to serve as a communication channel for information between the Graduate Group and students.

Every effort is made to create an environment of scholarship, creativity and learning, which is the very essence of graduate study.

APPENDIX A

A Sample 1st year Ph.D. Program in Mechanical Engineering & Applied Mechanics

Thermo/Fluids/Energy	Mechanics of Materials	Mechanical Systems & Robotics
1st Year - Fall		
ENM 5210- Principles and Techniques of Applied Mathematics II		
MEAM 5700 Transport Processes I	MEAM 5190 Elasticity and Micromechanics of Materials	MEAM 5350 Advanced Dynamics
Elective (MEAM or other research-related course)		
Elective (MEAM or other research-related course) or MEAM 9999		
MEAM 6990 Departmental Seminar		
EAS 9000 Responsible Conduct of Research in Engineering *You will be automatically registered for this course. This course is typically offered in the fall semester		
1st Year - Spring		
ENM 5200 Principles and Techniques of Applied Mathematics I		
MEAM 5610 Thermodynamics: Foundations, Energy, Materials	MEAM 5300 Continuum Mechanics	MEAM 6200 Advanced Robotics

Elective (MEAM or other research-related course)		
MEAM 8990 Independent Study (required for Qualifier Examination)		
MEAM 6990 Departmental Seminar		

APPENDIX B

Timeline for Ph.D. Students

By the End of Semester	Objectives
1	Define an independent study course for the spring
2	Submit independent study report by the last day of finals
2+one month	Oral presentation of the independent study paper and qualifying exam
2	Register for first teaching practicum
3	Register for second teaching practicum
4	Form a dissertation committee
4	Register for third teaching practicum
6	Present and obtain approval for a thesis proposal
8	Present a departmental seminar
	Submit a dissertation draft to your advisor
	Submit a revised dissertation draft to your dissertation committee
	Obtain committee's approval to schedule dissertation defense
TD-3weeks	Publicize dissertation defense
TD	Defend dissertation
	Make corrections and modifications to dissertation
GD-4 weeks	Submit a copy of the dissertation to the graduate group chair for approval
GD	Submit final dissertation to the graduate school
GD	Graduate

TD → thesis-defense date
GD → graduation date