UNIVERSITY of PENNSYLVANIA

Mechanical Engineering & Applied Mechanics
Master of Science in Engineering Program

GUIDELINES FOR GRADUATE STUDY

August 2025

Mechanical Engineering and Applied Mechanics
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INTRODUCTION

Advances in technology have increased the demand for mechanical engineers with more complete knowledge and diverse skills than a typical undergraduate program can provide. Graduates with a Master of Science in Engineering (MSE) degree can look forward to greater job opportunities, more rewarding positions, and higher levels of responsibility. Mechanical engineering, one of the broadest engineering disciplines, provides an excellent background for individuals interested in occupations ranging from product research and design to technological management. The Department of Mechanical Engineering and Applied Mechanics (MEAM) at the University of Pennsylvania has designed a flexible MSE Program to prepare students for professional careers and leadership roles in industry as well as opportunities to strengthen their knowledge and research skills.

The information presented here is not exhaustive; students can obtain more information on school and program policies from the Penn Engineering Graduate Student Handbook.

MEAM MSE students can also receive advice and answers to questions from their faculty advisors, the Master's Program Chair, or the Graduate Program Coordinator in the MEAM Department.

Students who matriculated before August 2024 are subject to the policies that were in effect as of their matriculation date. Students can visit the MEAM website to access their respective MEAM MSE Student Handbooks.

ADMINISTRATIVE STRUCTURE

MEAM Graduate Group

The MEAM Graduate Group administers MEAM's graduate programs and is comprised of MEAM's 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 mechanical engineering. The current members of the MEAM Graduate Group and their research areas can be viewed on the MEAM Graduate Group website.

All graduate programs in Penn Engineering are administratively under the auspices of the Office of Academic Services (OAS), which works closely with the MEAM Graduate Group Chair and the MEAM Master's Program Chair.

Faculty Advisor

Each MEAM MSE student is assigned a faculty advisor who works with the student to develop a program of study. The faculty advisor is responsible for monitoring the student's academic plan and, if applicable, thesis work. A student may request a change of advisor, if necessary, after the first semester which will be considered and approved by the Master's Program Chair.

DEGREE REQUIREMENTS

To earn an MSE degree in Mechanical Engineering and Applied Mechanics (MEAM), a student must complete 10 graduate level (5000 or above) courses and 2 semesters of seminar.

The MEAM MSE program has five (5) Concentrations of study. Students should choose a concentration area by their second semester of study. Students may change their concentration during their course of study.

- Design and Manufacturing
- Heat Transfer, Fluid Mechanics, and Energy
- Mechanics of Materials
- Mechatronic and Robotic Systems
- Micro/Nano Systems

MEAM Curriculum

Engineering Mathematics	2 Graduate-Level ENM or Pre-Approved Courses
MEAM Concentration Core	3 MEAM Courses • 1 MEAM Concentration Required Course • 2 MEAM Concentration Core Courses (from list)
MEAM Electives	2 MEAM Graduate-Level Courses (any 5000+ MEAM course except MEAM 5990 or MEAM 6990)
General Electives	3 Graduate-Level (5000+) Courses
Seminar Requirement	2 Semesters of MEAM 6990
Total	10 Courses + 2 Seminars

Engineering Mathematics Requirement:
Students are required to take two (2) graduate-level engineering math courses.

- The mathematics courses should be chosen from the approved list (see **Course Planning Worksheets**).

MEAM Concentration Core Courses:
Students are required to take at least three (3) graduate-level MEAM courses in their declared concentration:

- 1 required course, based on each concentration area (see **Course Planning Worksheets**).
- 2 additional courses from the Concentration Core (see **Course Planning Worksheets**).

MEAM Electives:
Students are required to take 2 additional graduate-level MEAM courses. These can include additional courses from the Concentration Core lists.

- MEAM 9990 (Master's Thesis Option) may count for up to 2 MEAM Elective Courses.

General Electives:
Students are required to take three (3) graduate-level courses that are relevant to the student's career goals or to their subdiscipline of interest.

- Students may reference a list of suggested General Elective courses for each concentration (see **Course Planning Worksheets**).
- Students may take any graduate-level Penn Engineering course to fulfill this requirement, including additional MEAM courses with approval from their faculty advisor.
- Students may count graduate-level courses outside of Penn Engineering with approval from their faculty advisor and the Master's Program Chair.
- Students may take up to two independent study courses (MEAM 5990). Independent study courses must follow the guidelines detailed in this manual and may only be counted as General Elective Courses.
- Students writing a Master's Thesis may not take an independent study course for additional degree credit.

Seminar Requirement:
Students must take 2 semesters of MEAM 6990 (see **MEAM Seminar Requirement** for more information).

Curriculum Exceptions or Changes
Any exceptions to the rules described above will be handled by petition. MEAM master's degree students may submit a MEAM Master's Degree Academic Program Request to the Master's Program Chair.

PROGRAM REQUIREMENTS

REGISTRATION AND ENROLLMENT

Full and Part Time Study

Students are considered full time if they are enrolled in a minimum of 3 CUs during a semester. Students are considered to be part time if they take 2.99 or fewer CUs in a single semester. MEAM MSE students are required to be continuously registered during Fall and Spring semesters.

Course Curriculum Planning

Each semester, a registration hold is placed on all MEAM graduate student accounts before Advance Registration. Students are required to check in and share their course plans with the department to get these holds lifted. Students should consult with their faculty advisors with questions about how different courses will best fit their career paths.

Most students complete the degree in two (2) years (four (4) academic semesters). Students are not expected to take courses during the Summer semesters. MEAM courses are not regularly offered during the summer (with the exception of MEAM 6990), but other courses from Penn Engineering may be offered.

Below are three possible course plans/schedules for the MEAM MSE program following a 2 year completion plan. The lighter course load in the second year gives students time for job hunting, interviewing, and other activities in preparation for post-graduation. International students may request a Reduced Course Load (RCL) in their final semester to fulfill their visa requirements.

Course Plan 1

Semester 1: Fall	Semester 2: Spring	Summer	Semester 3: Fall	Semester 4: Spring
3 CUs + MEAM 6990	3 CUs + MEAM 6990	Rest or Internship	3 CUs	1 CU (Requires RCL for International Students)

Course Plan 2

Semester 1: Fall	Semester 2: Spring	Summer	Semester 3: Fall	Semester 4: Spring
3 CUs + MEAM 6990	3 CUs + MEAM 6990	Rest or Internship (CPT for International Students)	2 CUs (+ EAS 8960 for full time status)	2 CUs (Requires RCL for International Students)

Course Plan 3

International students wishing to do an Academic Field Study (AFS) internship may use the following course plan. The AFS is usually a continuation of a summer Curricular Practical Training (CPT) internship. Domestic students may follow Course Plan 3 by taking a Leave of Absence during their 3rd semester.

Semester 1: Fall	Semester 2: Spring	Summer	Semester 3: Fall	Semester 4: Spring
3 CUs + MEAM 6990	3 or 4 CUs + MEAM 6990	Internship (CPT for International Students)	AFS	3 or 4 CUs

Students in the MEAM MSE program may take up to five courses in a semester if they are in excellent academic standing (with a GPA of 3.8 or better after at least 1 semester of full-time studies in the graduate program), with approval from their faculty advisor and the Master's Program Chair. Part-time students may take one or two courses per semester.

Curricular Practical Training (CPT) and Academic Field Study (AFS)

International students in the MEAM MSE program are eligible to count internships towards their MSE degrees through the CPT and AFS programs. Students are eligible to work off-campus in the US through a CPT or AFS program after completing 6 CUs of study. Students will work with the Graduate Program Coordinator to apply for a CPT or AFS. Students should refer to information about the CPT and AFS programs on their respective webpages. International students do not need to apply for CPT or AFS to work on campus.

Domestic students do not need to take CPT or AFS for their internships. Domestic students may request a Leave of Absence if they want to do an internship during a Fall or Spring semester.

Leaves of Absence:

Continuous registration as a graduate student is required unless a formal Leave of Absence is granted by the Dean of the Penn Engineering. Approved Leaves of Absence may last up to two years. Please refer to the Penn Engineering Graduate Student Handbook for more information about requesting a Leave of Absence.

Obsoleteness:

The maximum time allowed for the completion of all MSE requirements is seven years. Course units that are older than seven years may not be counted toward the degree requirements.

COURSE AND CURRICULUM POLICIES

Grades, Credits, and Academic Standing

The grading system is as follows: A (4.0), Excellent; B (3.0), Good; C (2.0), Fair; D (1.0), Poor; F (0.0), Failure. A course in which an F is obtained must be taken again; however, the F will remain on the student's transcript until the course has been satisfactorily completed with a passing grade. In accordance with Penn Engineering policy, "A grade of "F" cannot count towards the course requirements. If a student receives a grade of F, they must register for and take the same course again to receive a passing grade. Failed courses remain on the transcript and are included in the cumulative grade point average." Courses for which a passing grade was obtained (D or better) cannot be retaken for credit.

MSE students in Engineering are expected to maintain at least a B- average (2.7 GPA) in their work. A student whose record falls below a B- average will be put on academic probation and may be required to withdraw; graduation requires a B- average (2.7 GPA) minimum.

An incomplete (I) or a no report (NR) are notations indicating either extenuating circumstances that prevent a student from completing all requirements for a course (incomplete), or other circumstances that prevent an instructor from assigning a grade (no report). *No students will be permitted to graduate if there are any Incomplete, Unsatisfactory, or No Report notations on their records.* A student with 2 Incompletes in a single semester will be placed on academic probation.

Students with an incomplete grade (or grades), or who are put on academic probation, must work with the Graduate Program Coordinator and their Faculty Advisor to create a plan for resolving the incomplete grade(s), or for improving their GPA to be taken off Academic Probation.

Academic Integrity

Each MEAM student is expected to abide by Penn's Code of Academic Integrity. Students should not knowingly use any dishonest method(s) to gain an unfair advantage over other students in academic pursuits, especially through, 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 instructor;
- Misrepresenting the originality of one's work (plagiarism), particularly through direct copying of work including through failing to note the contributions of others, except as permitted by the instructor;
- 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 caught cheating 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.

SPECIFIC COURSE POLICIES

MEAM Seminar Requirement

Full-time MEAM MSE students and Accelerated Master's students must attend two semesters of the MEAM Seminar. The MEAM department seminars help expand the scope and learning for MEAM MSE students:

- The seminar provides an opportunity to learn about state-of-the-art research and issues in MEAM, including outside of students' specific or direct research interests.
- The seminar provides an opportunity for students to get acquainted with people from other institutions and companies.
- The seminars are an excellent opportunity to get together as a department. Students can meet peers as well as faculty members.

We strongly recommend that students take MEAM 6990 at least once during their first year of study. Students may count EAS 8960: Professional Master's Career Development once towards the MEAM Seminar Requirement.

Any exceptions to the MEAM Seminar requirement will be handled by petition (this includes exceptions for students doing the MEAM MSE program part time). MEAM MSE students may submit a petition using the MEAM MSE Academic Program Request form.

MEAM 6990: MEAM Seminar

MEAM 6990 recognizes students' attendance at the MEAM Seminar Series. MEAM 6990 is a zero (0) credit course that does not count towards a student's full-time status or the MEAM MSE program's 10 CU requirement. There are no tuition or fees assessed for this course.

MEAM 6990 is graded Satisfactory (S)/Unsatisfactory (U) and recorded on a student's transcript. To earn an S grade, the student must attend at least 70% of the departmental seminars and complete mini-essays for at least three of those seminars. For example, in a term in which there are 12 seminars, the student will need to attend at least 9 seminars to obtain an S grade. The three mini-essays can be spread over the semester (approximately one a month). Students may select which seminars they choose to write the mini-essays about.

Students may attend and count up to two non-MEAM seminars during the semester. 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 another technical discipline. Students may also count attendance at MEAM PhD and Master's defenses towards MEAM 6990 with prior approval. A mini-essay must be completed for each non-MEAM seminar, in order for these seminars to count towards the mini-essay requirement. There are no exams for this course.

Independent Study: MEAM 5990

Independent study courses (MEAM 5990) can accommodate special interests of the students that are not served through Penn Engineering's regular course offerings. They create opportunities for research projects and mentoring relationships between students and faculty. The student needs to identify the faculty supervisor, topic, and project scope during the semester prior to the one in which they intend to pursue the independent study.

MEAM 5990 may only count towards the General Elective requirement, and students may only take a maximum of two independent study courses towards their MEAM MSE degree. The faculty supervisor must be a MEAM Primary Faculty member or MEAM Graduate Group member.

Prior to the semester in which the student wants to take the independent study, the student and the faculty supervisor must develop a proposal:

- The first section of the proposal should describe the objectives, scope, content, and schedule of the independent study.
- The second section should state how the independent study will be evaluated and how the student will be graded. The deliverables must be explicitly listed and include specific due dates.
- The proposal should be approved by the faculty supervisor and then be submitted to the Graduate Program Coordinator, who will convey it to the Master's Program Chair for approval.

The independent study proposal must be approved at least three (3) weeks before the start of the semester in which the independent study will commence.

The following guidelines will help maintain the academic rigor of an independent study course:

- An independent study course should require a comparable amount of work to that of a regular course, about 9 hours a week, or a total of 126 hours per semester.
- The student and faculty supervisor should meet on a regular basis – we recommend at least once a week. It is the student's responsibility to schedule these weekly meetings.
- An independent study course's schedule should require steady work, ideally by setting assignments or progress checks throughout the semester. The student should not expect to be able to cram a semester's worth of work into a few days of intensive work at the end of the semester.

The independent study will conclude after the faculty supervisor submits a final grade for the course. 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 course.

MEAM MSE Thesis Option

While the majority of MSE students complete an entirely coursework-based degree, there is also an option to complete a thesis—an original research project—during the MSE degree program. This option is open to highly motivated, top MSE students and is subject to the availability of advisors with suitable research projects. Students doing a thesis typically complete the MSE in 2 years. Objectives of an MSE thesis project can include the following:

- To advance the state-of-the-art in research.
- To solve new problems with existing tools.
- To develop a new instrument or measurement technique, or a computer program for analysis or advanced design.

MEAM 9990: Master's Thesis Research

Students may take MEAM 9990 for up to three semesters, although the typically suggested length is 2 semesters. MEAM 9990 can be counted towards up to two (2) of the MEAM Electives requirement. One, two, or three units of MEAM 9990 may be taken in sequence, not simultaneously. Students should expect to take at least two semesters for the project and thesis writing. MEAM 9990 is graded by the student's thesis advisor.

Students may take MEAM 5990 (Independent Study) for one semester and then expand the project into a thesis by taking MEAM 9990 for a second semester of the project. Students taking this route must successfully complete MEAM 5990 and then submit a new proposal, for MEAM 9990, for approval by the MEAM MSE Program Chair and the MEAM Graduate Group Chair. The new proposal must clearly demonstrate how the Independent Study project will be expanded into a thesis, and how the same project will be expanded to demonstrate original research by the student. The thesis committee will evaluate the entire scope of the thesis, including the work completed during the Independent Study. Students hoping to extend their Independent Study project into a thesis are not guaranteed that their proposals will be approved. Students who choose to expand their independent study into a thesis, may petition to count MEAM 5990 towards their MEAM Electives requirement if their thesis proposal is approved.

Students may not combine two Independent Study courses and call them a thesis. Students doing a thesis cannot count additional independent study courses (MEAM 5990) as a part of their 10 course units requirement except by petition.

Thesis Track Options

<table>
<tr><th></th><th>Semester 1: Fall</th><th>Semester 2: Spring + Summer</th><th>Semester 3: Fall</th><th>Semester 4: Spring</th></tr>
<tr><td>Option 1 (most common)</td><td rowspan="2">Focus on getting good grades in core courses.

Learn more about faculty interests to identify a possible research project to conduct.</td><td>Continue focusing on getting good grades. By the end of the semester, identify thesis advisor and thesis committee member. Write and submit thesis proposal for approval.</td><td>Register for MEAM 9990

Perform research.</td><td rowspan="2">Register for MEAM 9990.

Perform and complete research. Write and defend thesis.</td></tr>
<tr><td>Option 2</td><td>Continue focusing on getting good grades. By the end of the semester, identify an advisor for an Independent Study project. Write and submit Independent Study proposal for approval.</td><td>Register for MEAM 5990. If the project could turn into a thesis, work with Independent Study Advisor to write thesis proposal. Identify thesis committee member and get their agreement to join committee. Submit thesis proposal for approval.</td></tr>
</table>

MSE Thesis Proposal & Committee

Students who choose to write a thesis must choose an advisor and a suitable thesis topic during their second semester of graduate study. The thesis advisor must be a member of the MEAM Graduate Group. If the identified thesis advisor is not the same as the student's faculty advisor, the student may request the Master's Program Chair (via the Master's Program Coordinator) change their faculty advisor to their thesis advisor.

The MEAM MSE Thesis Committee will be made up of 2-3 Penn faculty members: The thesis advisor, the thesis committee chair, and a thesis committee member (optional). The thesis advisor and the thesis committee chair must be MEAM Graduate Group members. The thesis advisor may not become and serve as the thesis committee chair. The optional third thesis committee member may be any Penn faculty member, with approval from the thesis advisor and the Graduate Group Chair.

The student will work with their thesis advisor to produce a written thesis proposal. The proposal should contain,

- a statement of the objective of the work,
- a literature review,
- a description of the scope of the study,
- an outline of the proposed final document, and
- a proposed timeline.

The student and thesis advisor will identify a MEAM Graduate Group member to serve on the thesis committee. The student should contact that faculty member (cc'ing the thesis advisor) with a draft of their proposal and get an agreement from the faculty member to serve on the thesis committee. The student will revise their proposal based on thesis advisor's and thesis committee member's feedback. The thesis advisor will evaluate and approve the revised proposal.

After the proposal is approved by the thesis advisor, the Graduate Program Coordinator will then forward the proposal to the Master's Program Chair and the Graduate Group Chair for approval and formal thesis committee appointment. The student must obtain approval of the thesis proposal at least three (3) weeks before the start of the semester in which they will take MEAM 9990 and begin the Master's Thesis research.

The student and thesis advisor may identify a Penn faculty member who is willing to serve as a third thesis committee member (optional). This faculty member will be appointed to the thesis committee by the Graduate Group Chair.

The Thesis and Defense

The thesis must be prepared and submitted following the general Penn Engineering and University of Pennsylvania guidelines. When the thesis has been approved by the thesis advisor, a copy of the thesis must be given to each member of the thesis committee for review. The student should allow at least two weeks for the review. If the committee feels that the thesis is suitable for presentation, the student may then proceed to the thesis defense. A public announcement of the presentation must be posted at least two weeks prior to the presentation.

The thesis defense is a public presentation of the work, after which the thesis committee will give final approval or disapproval. A typical thesis defense uses the following structure:

- Thesis presentation
- Public Q&A
- Closed-door Q&A with just the student and the thesis committee
- Closed-door deliberation by the thesis committee
- Discussion and decision between the student and the thesis committee

After the student successfully defends their thesis and completes any requested revisions recommended by the thesis committee, the final thesis must be signed by the thesis advisor and the MEAM Graduate Group Chair. Formatting requirements for the thesis can be found in the Penn Engineering Graduate Student Handbook. The finalized thesis must be submitted to the Office of Academic Services (OAS) and to the MEAM Graduate Program Coordinator by email. The thesis must be submitted by the University-specified date prior to commencement. Failure to follow the above schedule and requirements will result in a delay in awarding the student's degree.

Transfer of Credit Units Earned in Other Institutions

MEAM MSE students may apply credit for up to two graduate level courses taken at institutions other than Penn (transfer courses) toward their MSE degree with approval from the Master's Program Chair. Transfer courses must be graduate level courses in which at least a B grade has been earned. Transfer credit will only be considered for courses taken prior to matriculation into the University of Pennsylvania's MEAM MSE program, as Penn graduate students may not be enrolled in two schools at once.

Courses will not be allowed to be transferred if they were taken from an on-campus certificate program, a study abroad program, or from an online program. Per University policy, courses counted towards an undergraduate degree will not be considered for graduate credit. Courses taken during an approved and awarded accelerated master's program may be considered if the courses were only counted towards the graduate degree. Courses are held to a time limit of five (5) years from the date the course was taken.

To obtain credit for courses taken at other institutions, students need to take the following steps:

- For each transfer course, obtain the course description and the title of the textbook used in the course.
- Identify and contact a professor who teaches a similar course at Penn. If a similar course is not offered at Penn, identify and contact a professor whose areas of expertise are in the general area of the course to be transferred. The professor will need to certify that the course is of similar level to an existing graduate course offered at Penn.
- Submit a petition (see "Course Transfer Credit" under in the Penn Engineering Graduate Student Handbook), which requires the Penn professor's signature, to the Graduate Program Coordinator, who will convey it to the Master's Program Chair for approval. Attach to the petition a copy of the student's final transcript from the other institution.

ACADEMIC OPTIONS

DUAL MAJOR OR DEGREE PROGRAMS

Dual Major or Degree within Penn Engineering

Students may enroll in a Dual Major or Degree program. MEAM students doing a secondary MSE program in another Penn Engineering discipline (see list below) will receive a single MSE degree with 2 majors—a Dual Major. Students enrolled in a secondary program in a non-MSE Penn Engineering degree (see list below) will receive a Dual Degree. All Dual Programs require the completion of at least 16 CUs and satisfactory completion of the degree requirements of both programs. Students may double count up to 4 CUs between the two programs. Dual Programs typically require five or six semesters (3 years) to complete.

Penn Engineering students may apply for a Dual Program after completing at least one full semester (3 CUs) with a minimum GPA of 3.50. Students must meet with the MEAM MSE Program Coordinator and the Master's Program Coordinator of the second program prior to submitting their Dual Program application. Students should refer to Penn Engineering's Graduate Student Handbook for more information and instructions on how to apply.

MEAM MSE students may not do a Dual Major combining MEAM and ROBO MSE degrees. MEAM MSE students interested in doing a Dual Program should consult with the other program's Master's Coordinator to review any specific requirements or deadlines that program may have. Each student is only allowed to submit one application for a Dual Program during their studies at Penn Engineering.

Penn Engineering Master's Degree Programs

Master's of Science in Engineering Programs (MSE)

- Bioengineering
- Chemical and Biomolecular Engineering
- Computer Graphics and Game Technology
- Computer and Information Science
- Data Science
- Electrical Engineering
- Integrated Product Design
- Materials Science and Engineering
- Mechanical Engineering and Applied Mechanics
- Robotics
- Scientific Computing
- Systems Engineering

Other Master's Programs

- Biotechnology (MBIOT)
- Computer and Information Technology (MCIT)
- Integrated Product Design (MIPD)

Dual Degree Outside Penn Engineering

Penn Engineering has a dual degree agreement with the University of Pennsylvania Carey Law School. MEAM students interested in this program should refer to Penn Engineering's Graduate Student Handbook for more information and instructions on how to apply. Students should note that this program may require separate applications for the respective program(s) before approving the dual degree. The Carey Law School may not show preference for current Penn students in its admissions process.

Students interested in doing a Dual Degree with a program not listed in the Penn Engineering Graduate Student Handbook have the option to do an uncoordinated dual degree, but this is the equivalent of simply doing a second Master's degree. Students will need to independently apply to both programs.

TRANSFER TO ANOTHER PENN ENGINEERING PROGRAM

MEAM MSE students may request a transfer to another Engineering Master's Program after completing at least one semester (3+ CUs) by submitting the Master's Program Transfer form. Students need to meet with the MEAM MSE Program Coordinator and the Master's Program Coordinator of the new program prior to submitting their transfer request for consideration.

Completed applications should be submitted no later than the course selection deadline (first two weeks or 14 days of a semester) of the student's third semester. A student cannot request to transfer in their final semester. Candidates are expected to have the appropriate background for the master's program they are requesting to transfer into. Specific programs may have additional or particular requirements for internal transfers.

Each student is only allowed to submit one transfer application during their studies at Penn Engineering. Transferring master's programs is not guaranteed. MEAM MSE students are ineligible to transfer into the ROBO MSE program.

TRANSITION TO UPENN'S MEAM PHD PROGRAM

MSE students interested in pursuing a PhD after completing their MSE degree program should apply via the regular PhD application process by the posted deadline. Current students will receive an application fee waiver and can request that official transcripts and test scores be transferred from their master's application to their PhD application.

ACCELERATED MASTER'S PROGRAM

Outstanding undergraduate students at the University of Pennsylvania and participating schools may apply for an Accelerated Master's (AM) in the MEAM MSE degree program. Students in the AM program can earn the MEAM MSE in up to one additional year of study (1 or 2 semesters) after earning their bachelor's degrees. Undergraduate students at the University of Pennsylvania need to meet with both their Undergraduate Program Coordinator and the MEAM Master's Program Coordinator before applying to the program.

AM students must complete their undergraduate degree(s) in 8 semesters, or 10 semesters for students in select dual-degree programs. Undergraduate students in uncoordinated dual degrees are ineligible for the AM program. AM students may double-count up to three graduate-level courses towards both their undergraduate and the graduate degrees. AM students may also take additional graduate-level courses (which cannot be counted towards the undergraduate degree) during their undergraduate program(s) to complete their MSE degrees in fewer than 2 additional semesters (after they graduate from their undergraduate program(s)). No more than 50% of courses during a single semester may be designated for the master's degree before Accelerated Master's students graduate from their undergraduate program(s).

Students may count up to 3 CUs of graduate level (5000+) courses taken prior to matriculation into the AM program to count towards the master's degree. These courses must be used only as double counted courses, counting towards both the undergraduate and master's degrees. Any additional graduate level (5000+) courses (beyond the 3 CUs) taken prior to matriculation into the AM program will not be eligible to count towards the master's degree. These courses will remain only on the undergrad transcript. 4000-level courses cross-listed as 5000-level courses may be counted towards the MSE degree only if they were taken prior to matriculation into the AM program and they must be double-counted. AM students can only count graduate courses taken at the University of Pennsylvania towards the master's degree. No transfer credit, study abroad, or study away courses will be accepted.

AM students completing their undergraduate degrees at the University of Pennsylvania must meet the prerequisite or recommended undergraduate course requirements for MEAM graduate-level courses. Before AM students from the University of Pennsylvania graduate from their Bachelor's degree program(s), they fall under the governance of the University of Pennsylvania's undergraduate policies and rules.

The application for the AM program should be submitted during a student's sophomore or junior year. Learn more and find the application in the Penn Engineering Undergraduate Student Handbook.

MEAM accepts AM students from select external schools. Learn more about the Accelerated Master's program for non-Penn students in the Penn Engineering Graduate Admissions website.

GRADUATE STUDENT LEADERSHIP

The Department of Mechanical Engineering and Applied Mechanics encourages close interactions between graduate students and faculty. By encouraging student-faculty communication, we create an environment of scholarship, creativity and learning. The Department strongly supports the Mechanical Engineering Graduate Association (MEGA), a student-run association that represents the entire graduate student community in MEAM. MEGA organizes both social and technical events for graduate students. MEGA representatives are invited, if appropriate, to attend Graduate Group meetings to serve as a communication channel between the Graduate Group and students.

MEAM MASTER'S DEGREE CURRICULUM PLAN WORKSHEET

Use the Course Planning Sheets to fill out this Curriculum Plan Worksheet. No courses, except MEAM 6990, may appear more than once on this page (no double-counting). For descriptions of all MEAM courses and program requirements, please refer to the Course Catalog. For a list of the upcoming semester's course offerings, please refer to Courses@Penn (search "MEAM" to get MEAM's offerings). Students requesting permission to take courses outside of any of these lists can petition approval from the Master's Program Chair by filling out an Academic Program Request.

STUDENT NAME:

PENNID: **DATE:**

CONCENTRATION:

- ☐ Design and Manufacturing
- ☐ Mechatronic and Robotic Systems
- ☐ Heat Transfer, Fluid Mechanics, and Energy
- ☐ Micro/Nano Systems
- ☐ Mechanics of Materials
- ☐ Undeclared/Undecided

Engineering Mathematics Requirement

	Course Code	Course Name	Semester & Year
Course 1			
Course 2			

MEAM Concentration Required Course

	Course Code	Course Name	Semester & Year
Course 3			

MEAM Concentration Core Courses

	Course Code	Course Name	Semester & Year
Course 4			
Course 5			

MEAM Electives (may be additional MEAM Concentration Core Courses)

	Course Code	Course Name	Semester & Year
Course 6			
Course 7			

General Electives (may be additional MEAM Courses)

	Course Code	Course Name	Semester & Year
Course 8			
Course 9			
Course 10			

Seminar Requirement

	Course Code	Course Name	Semester & Year
Seminar 1			
Seminar 2			

Notes (Accelerated Master's and Dual Program students should note which courses they are double-counting here):

COURSE PLANNING WORKSHEETS

Use the Course Planning Sheets to help you select your courses. Below is a list of courses that will count towards your Engineering Math Requirement. The other worksheets are organized by Concentration. Note the semester in which the courses are usually offered, though all course offerings are subject to change.

For descriptions of all MEAM courses, please refer to the Course Catalog. For descriptions of the upcoming semester's course offerings, please refer to Courses@Penn (search "MEAM" to get MEAM's offerings).

Students requesting permission to count courses not on the lists provided can petition the Master's Program Chair for approval by filling out an Academic Program Request.

ENGINEERING MATHEMATICS REQUIREMENT

All MSE students are required to take at least two mathematics courses from the following list. Students may count courses outside of this list with approval from their faculty advisor and the Master's Program Chair by filling out an Academic Program Request.

In general, **students may take any graduate-level ENM course offered at the University to fulfill MEAM's Engineering Math Requirement**. The ENM courses are listed below to help you plan. There are also additional non-ENM courses that have been pre-approved to count towards the Engineering Math requirement.

Course	Title	Fall	Spring
ENM 5020	Numerical Methods and Modeling		X
ENM 5030	Introduction to Probability and Statistics	X	
ENM 5100	Foundations of Engineering Mathematics I	X	
ENM 5110	Foundations of Engineering Mathematics II		X
ENM 5120	Nonlinear Dynamics and Chaos		X
ENM 5200	Principles and Techniques of Applied Math I		X
ENM 5210	Principles and Techniques of Applied Math II	X	
ENM 5220	Numerical Methods for Partial Differential Equations		X
ENM 5310	Data Driven Modeling	X	
ENM 5320	AI4Science/Science4AI: Combining theoretical mechanics, numerical analysis, and machine learning		X
ENM 5400	Topics in Computational Science & Engineering		X
ENM 5500	Mathematics for Robotics	X	
CIS 5200	Machine Learning	X	X
MEAM 5270	Finite Element Analysis	X	

SEMINAR REQUIREMENT

All MEAM MSE students and MEAM Accelerated Master's students must take two semesters of the MEAM Seminar, MEAM 6990. See MEAM Seminar Requirement section in the MEAM MSE Student Handbook for more information.

DESIGN AND MANUFACTURING CONCENTRATION

Global business trends have created a demand for companies to rapidly develop new products at lower costs. In response to these demands companies have been exploring new methods to decrease costs, increase productivity, and create innovative products. In keeping with the needs of local industry the graduate courses below prepare students for careers in Product Design and Manufacturing. Students in the program will study topics such as mechatronics, CAD, computer graphics, industrial design, product design, materials engineering, manufacturing processes, assembly, tolerances, design analysis, plant/process modeling and design, robotics, electrical systems, mechanical systems, controls, intellectual property, and management skills. Graduates of the program will be prepared to be leaders in the global manufacturing environment. Much of our work involves collaborations with, among others, the Departments of Computer and Information Science, Electrical and Systems Engineering as well as the School of Design and the Wharton School of Business Administration.

MEAM Concentration Core Required Course

Course	Title	Fall	Spring	Rare
MEAM 5140	**Design for Manufacturability**		X	

MEAM Concentration Core Courses (2 Courses)

Select 2 courses from the following list.

Course	Title	Fall	Spring	Rare
MEAM 5040	Tribology		X	
MEAM 5060	Fail Analysis of Engineering Materials	X		
MEAM 5080	Materials and Manufacturing for Mechanical Design	X		
MEAM 5100	Design of Mechatronic Systems	X	X	
MEAM 5160	Advanced Mechatronic Reactive Spaces			X
MEAM 5270	Finite Element Analysis	X		
MEAM 5370	Nanomechanics and Nanotribology and Interfaces		X	
MEAM 5430	Performance, Stability and Control of UAVs		X	
MEAM 5500	Design of Microelectromechanical Systems			X

MEAM Electives (2 Courses)

Select 2 graduate-level MEAM courses. These can be additional Concentration Core courses, or from MEAM's overall offerings. For descriptions of all MEAM courses, please refer to the Course Catalog.

DESIGN AND MANUFACTURING CONCENTRATION (CONTINUED)

Suggested General Electives (3 courses)

Students may take any 3 graduate level courses that contribute to their degree program. In addition to more MEAM courses, students in the Design and Manufacturing concentration are pre-approved to count any of the following courses as General Electives. Students should consult their faculty advisor for approval of courses outside of this list.

Course	Title	Fall	Spring	Rare
ARCH 7260	Furniture Design		X	
CIS 5600	Interactive Computer Graphics	X	X	
EAS 5070	Intellectual Property and Business Law for Engineers	X	X	
EAS 5120	Engineering Negotiation	X	X	
EAS 5450	Engineering Entrepreneurship I	X	X	
EAS 5460	Engineering Entrepreneurship II	X	X	
EAS 5950	Foundations of Leadership		X	
ESE 5360	Nanofabrication and Nanocharacterization		X	
IPD 5010	Integrated Computer-Aided Design, Manufacturing and Analysis		X	
IPD 5040	Rehab Engineering & Design	X		
IPD 5090	Needfinding	X	X	
IPD 5110	How to Make Things	X		
IPD 5150	Product Design	X	X	
IPD 5250	Ergonomics/Human Factors Based Product Design	X		
IPD 5270	Industrial Design I		X	

HEAT TRANSFER, FLUID MECHANICS, AND ENERGY CONCENTRATION

Aerospace engineering, materials fabrication and manufacturing, cooling of microelectronic equipment, energy conversion and power generation, and thermal control and treatment of living organisms are critically important in today's economy. Our program in heat transfer, fluid mechanics, and energy is designed to provide the basic tools for dealing with these and other problems of current and future technological interest. The program maintains close collaboration with the departments of Chemical Engineering, Bioengineering, Electrical and Systems Engineering, and Materials Science.

MEAM Concentration Core Required Course

Course	Title	Fall	Spring	Rare
MEAM 5360	**Viscous Fluid Flow and Modern Applications**		X	
MEAM 5700	**Transport Processes I**	X		

MEAM Concentration Core Courses (2 Courses)

Select 2 courses from the following list.

Course	Title	Fall	Spring	Rare
MEAM 5020	Energy Engineering in Power Plants and Transportation Systems	X		
MEAM 5030	Direct Energy Conversion: From Macro to Nano	X		
MEAM 5040	Tribology		X	
MEAM 5180	Biomedical Microsystems	X		
MEAM 5270	Finite Element Analysis	X		
MEAM 5300	Continuum Mechanics		X	
MEAM 5360	Viscous Fluid Flow and Modern Applications		X	
MEAM 5380	Turbulence		X	
MEAM 5450	Aerodynamics	X		
MEAM 5460	Hovering Vehicle Design and Analysis Techniques		X	
MEAM 5480	Wind Energy and the Atmosphere	X		
MEAM 5490	Order-of-Magnitude Estimation	X		
MEAM 5610	Thermodynamics: Foundations, Energy, Materials		X*	
MEAM 5620	Water Treatment Engineering	X		
MEAM 5700	Transport Processes I	X		
MEAM 5710	Advanced Transport			X
MEAM 5750	Micro and Nano Fluidics		X	
MEAM 5800	Electrochemistry for Energy, Nanofabrication, and Sensing			X
MEAM 6420	Advanced Fluid Mechanics			X
MEAM 6460	Computational Mechanics	X		
MEAM 6620	Advanced Molecular Thermodynamics	X		
MEAM 6900	Advanced Topics in Thermal Fluid Science or Energy			X

*MEAM 5610 is offered every other year.

MEAM Electives (2 Courses)

Select 2 graduate-level MEAM courses. These can be additional Concentration Core courses, or from MEAM's overall offerings. For descriptions of all MEAM courses, please refer to the Course Catalog.

HEAT TRANSFER, FLUID MECHANICS, AND ENERGY CONCENTRATION (CONTINUED)

Suggested General Electives (3 courses)

Students may take any 3 graduate level courses that contribute to their degree program. In addition to more MEAM courses, students in the Heat Transfer, Fluid Mechanics, and Energy concentration are pre-approved to count any of the following courses as General Electives. Students should consult their faculty advisor for approval of courses outside of this list.

Course	Title	Fall	Spring	Rare
CBE 5050	Carbon Capture		X	
CBE 5450	Elec. Energy Conv. & Storage	X		
CBE 5460	Fundamentals of Industrial Catalytic Processes		X	
CBE 6180	Advanced Molecular Thermodynamics			
CBE 6400	Transport Processes I	X		
EAS 5010	Energy and Its Impacts	X		
EAS 5020	Renewable Energy and Its Impacts: Technology, Ecology, Economics, Sustainability		X	
EAS 5070	Intellectual Property and Business Law for Engineers	X	X	
EAS 5120	Engineering Negotiation	X	X	
EAS 5450	Engineering Entrepreneurship I	X	X	
EAS 5460	Engineering Entrepreneurship II	X	X	
EAS 5950	Foundations of Leadership		X	
MSE 5250	Nanoscale Science and Engineering	X		
MSE 5450	Materials for Energy and Environmental Sustainability	X		
MSE 5550	Elasticity and Micromechanics of Materials	X		

MECHANICS OF MATERIALS CONCENTRATION

The development of new technologies often depends critically on the availability of materials systems capable of withstanding extreme thermomechanical loading conditions. Current examples are provided by the development of advanced engines in the aerospace industry and the design of microchips that are resistant to thermal cycling in the microelectronics industry. In addition, new technologies, such as biomedical technologies, often require the development and understanding of completely new classes of materials systems. The Penn MEAM MSE in Mechanics of Materials is designed to provide the fundamental tools needed to tackle these and other problems of current and future technological interest. These include basic courses in continuum mechanics, elasticity, and plasticity, as well as more advanced ones in fracture, composite materials, biomechanics, and atomistic modeling of materials. The program maintains close collaborations with the Material Science Department and with the bio-medical community.

MEAM Concentration Core Required Course

Course	Title	Fall	Spring	Rare
MEAM 5190	**Elasticity and Micromechanics of Materials**	X		

MEAM Concentration Core Courses (2 Courses)

Select 2 courses from the following list.

Course	Title	Fall	Spring	Rare
MEAM 5040	Tribology		X	
MEAM 5050	Mechanical Properties of Macro/Nanoscale Materials		X	
MEAM 5060	Failure Analysis of Engineering Materials	X		
MEAM 5070	Fundamentals of Materials	X		
MEAM 5080	Materials and Manufacturing for Mechanical Design	X		
MEAM 5270	Finite Element Analysis	X		
MEAM 5300	Continuum Mechanics		X	
MEAM 5370	Nanomechanics and Nanotribology and Interfaces		X	
MEAM 5530	Atomic Modeling in Materials Science	X		
MEAM 5550	Nanoscale Systems Biology	X		
MEAM 6320	Plasticity			X
MEAM 6330	Mechanics of Adhesion and Fracture		X	
MEAM 6340	Rods & Shells			X
MEAM 6350	Composite Materials			X
MEAM 6630	Mechanics of Macromolecules			X
MEAM 6640	Multiscale Modeling for Non-Equilibrium Material Behavior			X
MEAM 6910	Special Topics in Mechanics of Materials			X

MEAM Electives (2 Courses)

Select 2 graduate-level MEAM courses. These can be additional Concentration Core courses, or from MEAM's overall offerings. For descriptions of all MEAM courses, please refer to the Course Catalog.

MECHANICS OF MATERIALS CONCENTRATION (CONTINUED)

Suggested General Electives (3 Courses)

Students may take any 3 graduate level courses that contribute to their degree program. In addition to more MEAM courses, students in the Mechanics of Materials concentration are pre-approved to count any of the following courses as General Electives. Students should consult their faculty advisor for approval of courses outside of this list.

Course	Title	Fall	Spring	Rare
BE 5500	Continuum Tissue Mechanics		X	
EAS 5070	Intellectual Property and Business Law for Engineers	X	X	
EAS 5120	Engineering Negotiation	X	X	
EAS 5450	Engineering Entrepreneurship I	X	X	
EAS 5460	Engineering Entrepreneurship II	X	X	
EAS 5950	Foundations of Leadership		X	
IPD 5010	Integrated Computer-Aided Design, Manufacturing, and Analysis		X	
IPD 5150	Product Design	X	X	
MSE 5020	Sustainability of Materials		X	

MECHATRONIC AND ROBOTIC SYSTEMS CONCENTRATION

Ongoing effort in mechanical systems focuses on modeling and controlling dynamical systems, especially as applied to mechatronic and robotic systems. The graduate courses provide students with a firm theoretical foundation and the interdisciplinary experimental skills that are necessary for dealing with modern-day complex systems. Much of our work involves collaborations with Computer and Information Science and Electrical and Systems Engineering, as well as the Wharton School of Business Administration.

MEAM Concentration Core Required Course

Course	Title	Fall	Spring	Rare
MEAM 5100	**Design of Mechatronic Systems**	X	X	

MEAM Concentration Core Courses (2 Courses)

Select 2 courses from the following list.

Course	Title	Fall	Spring	Rare
MEAM 5130	Feedback Control Design and Analysis		X	
MEAM 5160	Advanced Mechatronic Reactive Spaces			X
MEAM 5170	Control and Optimization with Applications in Robotics	X		
MEAM 5200	Introduction to Robotics	X	X	
MEAM 5230	Control Systems for Robotics			X
MEAM 5290	Introduction to Micro- and Nano-electromechanical Technologies		X	
MEAM 5350	Advanced Dynamics	X		
MEAM 5430	Performance, Stability and Control of UAVs		X	
MEAM 5460	Hovering Vehicle Design and Analysis Techniques		X	
MEAM 5500	Design of Microelectromechanical Systems			X
MEAM 6130	Nonlinear Control Theory			X
MEAM 6200	Advanced Robotics		X	
MEAM 6230	Learning and Control for Adaptive and Reactive Robots		X	
MEAM 6240	Distributed Robotics		X*	
MEAM 6920	Topics in Mechanical Systems			X

*MEAM 6240 is offered every other year.

MEAM Electives (2 Courses)

Select 2 graduate-level MEAM courses. These can be additional Concentration Core courses, or from MEAM's overall offerings. For descriptions of all MEAM courses, please refer to the Course Catalog.

MECHATRONIC AND ROBOTIC SYSTEMS CONCENTRATION (CONTINUED)

Suggested General Electives (3 Courses)

Students may take any 3 graduate level courses that contribute to their degree program. In addition to more MEAM courses, students in the Mechatronic and Robotic Systems concentration are pre-approved to count any of the following courses as General Electives. Students should consult their faculty advisor for approval of courses outside of this list.

Course	Title	Fall	Spring	Rare
CIS 5200	Machine Learning	X	X	
CIS 5210	Fundamentals of AI	X	X	
CIS 5400	Principles of Embedded Computation	X		
CIS 5800	Machine Perception	X	X	
CIS 5810	Computer Vision and Computational Photography	X	X	
CIT 5900	Programming Languages and Techniques	X	X	
EAS 5070	Intellectual Property and Business Law for Engineers	X	X	
EAS 5120	Engineering Negotiation	X	X	
EAS 5450	Engineering Entrepreneurship I	X	X	
EAS 5460	Engineering Entrepreneurship II	X	X	
EAS 5950	Foundations of Leadership		X	
ESE 5000	Linear Systems Theory	X		
ESE 5060	Introduction to Optimization Theory	X		
ESE 5190	Smart Devices	X		
ESE 5310	Digital Signal Processing		X	
ESE 5400	Engineering Economics	X		
ESE 5430	Human Systems Engineering	X	X	
ESE 6050	Modern Convex Optimization		X	
ESE 6500	Learning in Robotics		X	
ESE 6150	F1/10 Autonomous Racing Cars		X	
IPD 5010	Integrated Computer-Aided Design, Manufacturing and Analysis		X	

MICRO/NANO SYSTEMS CONCENTRATION

Micro/Nano systems is a broad field encompassing the design, development, and fabrication of devices and systems that derive unique functionality due to the small size of key components within them. Examples of such systems include microelectromechanical systems (MEMS), nanoelectronic devices, and microfluidics. Mechanical Engineering plays a central role in all of these systems, such as the mechanical design of MEMS-based sensors and the understanding of heat transfer in nanoelectronics. The graduate courses in this area of concentration provide students with a solid theoretical foundation, knowledge of micro/nano-fabrication techniques, and skills to design micro/nano systems.

MEAM Concentration Required Course

Course	Title	Fall	Spring	Rare
MEAM 5290	**Introduction to Micro- and Nano-electromechanical Technologies**		X	
MEAM 5370	**Nanomechanics and Nanotribology and Interfaces**		X	

MEAM Concentration Core Courses (2 Courses)

Select 2 courses from the following list.

Course	Title	Fall	Spring	Rare
MEAM 5050	Mechanical Properties of Macro/Nanoscale Materials		X	
MEAM 5070	Fundamentals of Materials	X		
MEAM 5180	Biomedical Microsystems	X		
MEAM 5190	Elasticity and Micromechanics of Materials	X		
MEAM 5270	Finite Element Analysis	X		
MEAM 5290	Introduction to Micro- and Nano-electromechanical Technologies		X	
MEAM 5370	Nanomechanics and Nanotribology and Interfaces		X	
MEAM 5500	Design of Microelectromechanical Systems			X
MEAM 5530	Atomic Modeling in Materials Science	X		
MEAM 5550	Nanoscale Systems Biology	X		
MEAM 5750	Micro and Nano Fluidics		X	
MEAM 5800	Electrochemistry for Energy, Nanofabrication, and Sensing		X	

MEAM Electives (2 Courses)

Select 2 graduate-level MEAM courses. These can be additional Concentration Core courses, or from MEAM's overall offerings. For descriptions of all MEAM courses, please refer to the Course Catalog.

MICRO/NANO SYSTEMS CONCENTRATION (CONTINUED)

Suggested General Electives (3 Courses)

Students may take any 3 graduate level courses that contribute to their degree program. In addition to more MEAM courses, students in the Micro/Nano Systems concentration are pre-approved to count any of the following courses as General Electives. Students should consult their faculty advisor for approval of courses outside of this list.

Course	Title	Fall	Spring	Rare
EAS 5070	Intellectual Property and Business Law for Engineers	X	X	
EAS 5120	Engineering Negotiation	X	X	
EAS 5450	Engineering Entrepreneurship I	X	X	
EAS 5460	Engineering Entrepreneurship II	X	X	
EAS 5950	Foundations of Leadership		X	
ESE 5210	The Physics of Solid State Energy Devices		X	
ESE 5360	Nanofabrication and Nanocharacterization		X	
MSE 5200	Structure of Materials		X	
MSE 5250	Nanoscale Science and Engineering	X		
MSE 5650	Fabrication and Characterization of Nanostructured Devices		X	