

LEHIGH UNIVERSITY

**DEPARTMENT OF MECHANICAL
ENGINEERING
AND MECHANICS**

**GRADUATE DEGREE
PROGRAM GUIDELINES**

January 18, 2023

*Includes checklist for implementation of new version of
General Examination for Doctoral Track Students*

DEGREE PROGRAM REQUIREMENTS*
ALL TYPES OF MASTER'S DEGREES

UNIVERSITY REQUIREMENTS FOR ALL TYPES OF MASTER'S DEGREES

In meeting the requirements for all existing and new Master's degrees in the Department of Mechanical Engineering and Mechanics, the student must satisfy the following common (University) requirements, as outlined in the Graduate Student Handbook.

1) Each candidate for the Master's degree must complete the form "Program for Master's Degree," setting forth the courses proposed to satisfy the degree requirements. This program must have the approval of the chairperson of the student's major department. All courses included that are not offered by the student's major department also must be approved by the chairpersons of the departments concerned. The program of courses must be submitted to and approved by the Graduate and Research Committee. Submission should be as soon as possible after 15 credit hours toward the degree have been completed. Approval of the program by this committee signifies that the student has formally been admitted to candidacy for the degree.

2) The "minimum" program for the Master's degree includes:

- not less than 30 credit hours of graduate work; audit credits may not be used toward the degree; research or thesis registration counts as part of the 400-level coursework requirement
- not less than 24 credit hours of 300- and 400-level coursework, of which 18 credit hours must be at the 400-level
- not less than 18 credit hours in the major field, of which 15 credit hours must be at the 400-level

3) The 18 credit hours required in the major field are ordinarily taken in one department with exceptions for those programs that are interdisciplinary. Specific exceptions to this rule are mentioned in the departmental statements at the head of course listings. The remaining twelve hours of a "minimum" program, or any part of them, may also be taken in the major department, or they may be taken in any other field in which courses for graduate credit are offered, as the needs or interests of the student may indicate, subject to the approval of the chairperson of the major department. In all cases, the course work for the Master's degree is taken under at least two instructors.

4) A graduate student may include in his or her program courses numbered 200 or higher outside the major field and courses numbered 300 or higher in the major field. A graduate student registered in 200 or 300 courses may be assigned additional work at the discretion of the instructors. Advisor and/or department approval is required in order to register for a 200-level course.

5) The Master's degree is not granted unless the candidate has earned the grades of "B-" or better in at least eighteen hours of the work on his or her program AND in all 300 courses in the major field. No course in which the grade earned is less than "C-" is credited toward the degree.

*Each degree candidate is responsible for ensuring that his/her program is compatible with the degree requirements given in the most recent version of the Lehigh University Catalog and the Graduate Student Handbook of the P. C. Rossin College of Engineering and Applied Science:

http://www.lehigh.edu/engineering/pdf/graduate_student_handbook.pdf

6) All work which is to be credited toward a Master's degree must be done through or approved by the appropriate academic unit of Lehigh University. A student who receives more than four grades below “B-” in courses numbered 200 or higher becomes ineligible to qualify for the Master’s degree or to register for any other 400-level courses.

NEW VERSION OF MASTER OF SCIENCE DEGREE THAT IS EFFECTIVE FOR INCOMING STUDENTS AS OF SUMMER 2020

The program for the Master of Science degree requires a minimum of 30 credit hours, distributed as follows.

Group I: Required Core Course in Engineering Mathematics:		3
<u>ME 452</u>	Mathematical Methods In Engineering I	
Group II: Required Core Courses in Mechanical Engineering (2 courses):		6
<u>ME 402</u>	Advanced Manufacturing Science	
<u>ME 413</u>	Numerical Methods in Mechanical Engineering	
<u>ME 423</u>	Heat and Mass Transfer	
<u>ME 430</u>	Advanced Fluid Mechanics	
<u>ME 433</u>	Linear Systems and Control	
<u>ME 453</u>	Mathematical Methods In Engineering II	
<u>MECH 406</u>	Fundamentals of Solid Mechanics***	
<u>MECH 408</u>	Introduction to Elasticity***	
<u>MECH 425</u>	Analytical Methods in Dynamics and Vibrations	
<u>MECH 450</u>	Advanced Mechanics of Materials	
Group III: Three other MEM courses at the 300 and 400 level. (Only one course may be at the 300 level).		9
Group IV: Up to 4 free electives (12 credits) approved by the Graduate Program Coordinator or the Student’s Advisor		12

***Only one of these courses can be used for core course requirement

There are four options** for the Master of Science degree:

1. MS-Thesis Option: 6 credits of ME 490 (Thesis) must be taken as part of the free electives. If the student wishes to pursue a PhD, course requirements should following the PhD requirements (2 math courses, 3 core courses, 2 depth courses, 1 breadth course).

2. MS-Project Option: 6 credits of ME 460 (Project) must be taken as part of the free electives.
3. MS-Applied Engineering Option: 6 credits of course-work in MEM taken as part of the free electives.
4. MS-Interdisciplinary Engineering Option: 12 credits of coursework outside MEM to satisfy the free electives.

**These options correspond to courses selected from Group IV of the foregoing overview: up to 4 free electives (12 credits) approved by the Graduate Program Coordinator or the Student's Advisor.

Students should ensure that all courses for the Master of Science degree satisfy the distribution requirements of the University for all Master's Degrees.

For students pursuing the Master of Science degree with a thesis, it is necessary to obtain the agreement of a faculty member willing to supervise the thesis research and to submit the Advisor Selection Form. Those pursuing the Master of Science degree with a project should secure the agreement of a faculty member who will supervise the (ME 460) project and submit the Graduate Engineering Project Permission Form. The availability of faculty for research and project supervision depends on the specialty within the area of mechanical engineering and the ongoing advisory commitments of the faculty member during a given semester. Those students who wish to pursue the Master of Science degree with a thesis or project should contact faculty members in their area of interest during their first semester of study.

Plan for Master of Science Degree All students pursuing this degree must complete a Department-level form entitled *Plan for Master of Science Degree* immediately prior to or at the beginning of the first semester of study towards the new Master of Science degree. The student will specify which of the four possible tracks toward the M.S. degree is being pursued and will indicate a preliminary plan of courses to satisfy the degree requirements. The purpose of this form is to ensure that both the student and the advisor are fully aware of the courses required for the selected track of the new Master of Science degree. It should be emphasized that the course plan is viewed as preliminary, and can be modified as the student progresses through the program.

Program for Master's Degree Form All Master's students must satisfy a University-wide requirement and complete the form entitled Program for Master's Degree when 15 credit hours have been taken, and no later than the semester preceding the graduation semester. If you decide to pursue the new Master of Science degree, you must submit a new (revised) Program for Master's Degree if you have already submitted this form for one of the existing Master's Degrees.

Department Requirement: All students are required to attend a minimum number of Mechanical Engineering and Mechanis seminars.

DEGREE PROGRAM REQUIREMENTS*
DOCTOR OF PHILOSOPHY DEGREE
Mechanical Engineering and Mechanics

ABBREVIATED OVERVIEW OF REQUIREMENTS FOR THE PhD DEGREE AND CRITICAL TIMELINES FOR FULL-TIME STUDENTS

1. Select a PhD adviser, then complete and submit the Adviser Selection Form.

2. Complete five core courses with a minimum GPA of 3.35/4.0 within the first three semesters of graduate study. The student must use the first five core courses taken for the gpa calculation. Core courses may not be retaken. (If ME 453 is not taken as part of the core course sequence, it must be taken at a later point.)

This requirement represents the first stage of candidacy at the Department level

3. Form the PhD Committee (required for administration of General Examination).

4. Complete the General Examination. Students who start their PhD program as of the Fall 2018 semester must take the new form of the General Examination. The new form of the General Examination is taken by the fourth semester when the core course requirements will have been completed. Note: The University requirement is that the General Examination must be completed no later than seven months prior to the time when the candidate plans to receive the degree.

This requirement represents the second stage of candidacy at the Department level.

5. Write the proposal for the PhD program. The proposal includes the proposed research and the course plan. For students starting their PhD program as of the Spring 2019 semester or thereafter, the course plan must include three additional depth and breadth courses beyond the five core courses.

6. Present the PhD proposal to the PhD Committee no later than the end of the semester following the semester in which the General Exam was passed.

7. File for PhD candidacy at the College level. After the proposal is approved by the PhD Committee, submit the completed DocuSign General Exam signature page, the completed DocuSign Proposal signature page, a copy of the proposal, and a completed Application to Candidacy form to Ms. Brie Lisk, 314A Packard Lab. Approval of the proposal by the Associate Dean admits the student to candidacy for the PhD in the P. C. Rossin College of Engineering and Applied Science.

8. Present the dissertation research. A dissertation defense announcement is sent to all faculty and graduate students at least one week prior to the defense presentation.

*Each degree candidate is responsible for ensuring that his/her program is compatible with the degree requirements given in the most recent version of the Lehigh University Catalog and the Graduate Student Handbook of the P. C. Rossin College of Engineering and Applied Science:

http://www.lehigh.edu/engineering/pdf/graduate_student_handbook.pdf

COURSE REQUIREMENTS FOR THE PhD

NEW PhD COURSE REQUIREMENTS EFFECTIVE FOR STUDENTS WHO START THE PhD DEGREE AS OF FALL 2021 OR THEREAFTER.

Students pursuing the PhD must complete a total of eight courses. Five of these courses are the required core courses and three are depth and breadth courses

Required Core Courses

Group I: Required Core Courses in Engineering Mathematics (two courses):	
<u>ME 452</u>	Mathematical Methods In Engineering I (plus one of the following courses)
<u>ME 453</u>	Mathematical Methods In Engineering II
or <u>ME 413</u>	Numerical Methods in Mechanical Engineering
Group II: Required Core Courses in Mechanical Engineering (minimum of 2 courses, up to three courses):	
<u>ME 423</u>	Heat and Mass Transfer
<u>ME 430</u>	Advanced Fluid Mechanics
<u>ME 433</u>	Linear Systems and Control
<u>MECH 406</u>	Fundamentals of Solid Mechanics***
<u>MECH 408</u>	Introduction to Elasticity***
<u>MECH 425</u>	Analytical Methods in Dynamics and Vibrations
<u>MECH 450</u>	Advanced Mechanics of Materials
Group III: Optional Core Course:	
<u>ME 402</u>	Advanced Manufacturing Science

***Only one of these courses can be used for core course requirement

Required Depth and Breadth Courses

In addition to the required core courses, it is necessary to complete:

- Two (2) graduate courses in the student's (MEM) emphasis area (depth requirement); and
- One (1) graduate course outside the (MEM) emphasis area but related to the student's research (breadth requirement).

A Group I math core course cannot be used to satisfy the breadth requirement. For students working in an interdisciplinary area, the advisor in coordination with the PhD committee possess the freedom to choose the most appropriate courses for the depth and breadth requirements.

PhD students must also take ME 453, which can either be taken as part of the five core course requirement or as an additional course.

GENERAL EXAMINATION

Only after attainment of a minimum GPA of 3.35/4.0 in the five core courses is a student allowed to proceed with the General Examination.

Immediately following successful completion of the core courses, the student forms the Doctoral Committee, which includes the dissertation advisor as the Committee Chair. The minimum number of committee members is four. Of these, three, including the Committee Chair, are to be voting Lehigh faculty members. With the written approval of the Dean of the College, one of the three aforementioned faculty members, each of whom must have a doctoral degree, may be drawn from categories that include departmentally- approved adjunct, professors of practice, university lecturers, and courtesy faculty appointees. This latter member may not serve as the Committee Chair. The fourth required member must be from outside the student's Department (or outside the student's program if there is only one Department in the college). Committees may include additional members who possess the requisite expertise and experience. The Doctoral Committee is responsible for both administration of the General Exam and oversight of the student's program of study.

Committee members must be approved by the University's Graduate and Research Committee; such approval may be delegated to the department or program sponsoring the degree.

The Doctoral Committee is responsible for both administration of the General Exam and oversight of the student's program of study.

NEW VERSION OF GENERAL EXAMINATION THAT APPLIES TO STUDENTS WHO START THEIR PhD PROGRAM AS OF FALL 2018 AND THEREAFTER

The new version of the General Examination is completed during the fourth semester of graduate study.

Students taking the General Examination should register for three credits of the General Examination course ME 440. The advisor of the PhD student should request, through the Associate Chair of the Department, her/his own section of ME 440 for this purpose prior to the start of the semester of the General Examination.

During the first half of the fourth semester, the advisor assigns a topic to the student after discussion with the student and approval of the Doctoral Committee. The student then does a literature search and defines several major unresolved issues in a report that should not exceed seven (7) pages of text. During the second half of the semester, the student formulates a research proposal that aims to clarify the underlying principles of the originally defined topic, while addressing the major unresolved issues. The format will conform to the guidelines for a proposal of a major funding agency (NSF, NIH, DOE, DOD) and will not exceed ten (10) pages of text.

The student submits the proposal to the Doctoral Committee and schedules the oral exam by the last day of class. The Committee decides on a grade to be assigned upon completion of the three credit General Examination course (ME 440). The General Examination must be passed at least seven months before the degree is to be conferred.

CHECKLIST FOR IMPLEMENTATION OF NEW VERSION OF GENERAL EXAMINATION THAT APPLIES TO STUDENTS WHO START THEIR PhD PROGRAM AS OF FALL 2018 AND THEREAFTER

1. Upon successful completion of the core course requirement, the student forms the Ph.D. Committee in accord with University guidelines, which are given at several locations: the [RCEAS Graduate Student Handbook](#), the University catalog, and the Graduate Degree Program Guidelines in the Department of Mechanical Engineering and Mechanics.
2. The General Examination is given by the fourth semester of graduate study. Prior to the start of the semester, the student's advisor should request the Associate Chair of the MEM Department to create a section of ME 440 General Examination with the student's advisor designated as the instructor.
3. At the beginning of the first half of the fourth semester, the student's advisor, in consultation with, and approval of, the Doctoral Committee, decides on the topic of the General Examination. The advisor then assigns the topic to the student. It is recommended that the assigned topic be described in a single paragraph, and accompanied by one to three relevant journal articles.
4. The student performs a literature search that critically assesses the state of the art of the assigned topic. This assessment should lead to the definition of several major unresolved issues in a report that should not exceed seven (7) pages of text. *It is strongly recommended that these unresolved issues be described in terms of basic physical concepts.*
5. No later than the midpoint of the semester, the student submits the report containing the critical assessment of literature and the unresolved issues to the Doctoral Committee. Each member of the Committee reads the report as soon as possible, decides whether to approve it, then conveys the decision to the student's adviser.
6. If the overall decision of the Doctoral Committee on item (5) is positive, the student's adviser requests the student to formulate a research proposal that aims to clarify major unresolved issues. *It is highly recommended that the research proposal focus on a deeper understanding of the basic physical concepts associated with only one or two unresolved issues.*
The final version of the research proposal will be in a format that conforms to the guidelines for a proposal of a major funding agency (NSF, NIH, DOE, DOD). The proposed research should not exceed ten pages, which is in addition to the maximum of seven pages of text of the literature search described in item (4). Excerpts from the literature search may be used to provide background information in the final version of the proposal; if this is done, the total length of the document should not exceed 15 pages. The cited references are not included in this page count. The student's adviser may adjust the number of pages indicated in the foregoing to suit the nature of the assigned topic.
7. The student provides each member of the Doctoral Committee with the research proposal and schedules a presentation. It is recommended that the duration of the presentation not exceed 30 minutes. Immediately following the presentation, an oral examination is given on the contents of the presentation and associated physical principles. *It is recommended that the oral examination have a minimum duration of one hour in order to allow sufficient time for thorough discussion.*
8. At the end of the oral examination, the Committee determines the grade to be assigned to the associated course ME 440 General Examination. The grade should take into account the report on critical assessment of the literature, the research proposal, and the student's performance on the oral examination. *In order to pass the General Examination, a minimum grade of B+ must be assigned to ME 440.* If a grade of incomplete is assigned, so that the student can do an additional assignment to address a shortcoming on the General Examination, the Committee should clearly establish a deadline, typically of the order of a few weeks, for removal of the incomplete. On the other hand, if the Committee assigns a grade below B+, the student may take the Exam again, but

on a different topic than the original Exam. The General Examination can be taken only twice.

9. It is recommended that the advisor meet with the student immediately after the decision on the assigned grade, in the absence of other members of the Committee, in order to inform the student of the exam grade and provide constructive feedback.

RESEARCH PROPOSAL AND FILING FOR CANDIDACY AT THE COLLEGE LEVEL

During the semester following completion of the General Examination (e.g., the Fall semester following completion of the General Examination during the Spring semester), the student completes a research proposal and applies for formal PhD candidacy at the College level. Formulation of the research proposal for the doctoral program includes not only the research plan, but also an outline of all coursework. The student presents the proposal in both written and oral form to his/her Doctoral Committee for approval.

Upon Committee approval, the proposal is submitted to the Associate Dean of Graduate Studies of the P. C. Rossin College of Engineering and Applied Science. In addition to the approved proposal, the student submits the original General Exam Signature page, the original Proposal Signature page, a copy of the proposal, and a completed Application to Candidacy form. These documents are given to Ms. Brie Lisk, 314A Packard Lab. Approval of the proposal by the Associate Dean admits the student to candidacy for the PhD in the P. C. Rossin College of Engineering and Applied Science.

DISSERTATION PREPARATION AND DEFENSE

Upon completion of coursework and research, the candidate prepares a dissertation describing the results and conclusions of his/her research. A written dissertation draft is submitted to the Doctoral Committee, and the candidate presents a public defense of the dissertation. A dissertation defense announcement must be sent to all faculty and graduate students in the department and posted within the department at least one week before the defense is given. A satisfactory defense of the dissertation and acceptance of the written draft by the Doctoral Committee completes the Departmental requirements for the doctoral degree. To complete the degree requirements, especially in this final phase, the dissertation must also conform to the timing and guidelines of the P. C. Rossin College of Engineering and Applied Science, as described in the College Graduate Student Handbook. Candidates should be especially aware of strict timelines for submitting drafts of the dissertation; these timelines are indicated in the [academic calendar](#) and are available from the Registration and Academic Services Office.

ADDITIONAL REQUIREMENTS

Requirements in effect for students who start the PhD degree as of Fall 2018

- Two or more manuscripts must be submitted for (peer-reviewed) journal publication prior to the dissertation defense. At least one of these manuscripts must have gone through a first (external) review process. A student may petition, with detailed justification, to account for unusual preparation efforts, for example: submittal of a single manuscript to an extraordinarily competitive journal; an unreasonably long review time for a submitted manuscript; and alternate products consistent with the indicators of scholarship in the student's area of research.
- The minimum number of department seminars must be attended by the student during the course of the PhD program.

REPLACEMENT CORE COURSE

Effective for students who start their PhD program as of Spring 2019 (All students may, however, petition for a replacement course at any time)

A minimum GPA of 3.35/4.0 (based on the first five graduate core courses taken) must be attained. This minimum GPA requirement represents the first stage of candidacy for the PhD degree at the Department level. If the minimum requirement is not met, the student may petition to: (a) take one replacement course from the same Group I, II or III of core courses; or (b) take one replacement course in the form of a (non-core) advanced course, but only after the petition is approved and the course instructor is made aware of the student's petition for grade replacement. All petitions require approval of the PhD advisor, then approval of the Graduate Committee.

TRANSFER OF COURSES TAKEN AT ANOTHER UNIVERSITY

Effective for students who start their PhD program as of Spring 2019 (All students may, however, petition for this type of course transfer at any time)

A student pursuing the PhD after completion of an MS/MSc degree from another institution may petition to have two courses taken at that institution be approved as equivalent to MEM core courses, with no more than one course equivalent to a Lehigh Group I core course (math course) and one course equivalent to a Group II core course (course in a fundamental subject area). In addition, the student may petition to substitute courses taken elsewhere for the two (2) non-core advanced courses in their subject area (depth requirement) and the one (1) non-core course outside their emphasis area (breadth requirement). All of the foregoing replacement courses must be approved by the instructor of the corresponding Lehigh course. The student must submit a petition with the following: (a) a syllabus in English or a sufficiently detailed print-out of the course catalog from the MS institution; (b) a letter of support or a signed petition from the PhD advisor; and (c) any additional documentation beyond the syllabus as requested by the instructor. If permission is granted for the foregoing replacement courses, three (3) core courses will remain for completion at Lehigh.

UNIVERSITY AND DISTANCE EDUCATION RESIDENCY REQUIREMENTS

University Residency Requirement for Distance Education PhD Students

Concentrated Learning Requirement: To fulfill the concentrated learning requirement for the doctoral degree, a candidate must complete two semesters as a full-time graduate student or at least 18 credit hours of Lehigh graduate study within a fifteen-month period either on or off campus. The concentrated learning requirement is intended to ensure that doctoral students spend a period of concentrated study and intellectual association with other scholars. Individual departments may impose additional stipulations. Candidates should check with their advisors to be certain that they have satisfied their concentrated learning requirements.

Department Residency Requirement for Distance Education PhD Students

After a PhD student has passed the General Examination, PhD students who perform their research at a remote location are required to spend two days of intellectual association at Lehigh during each semester of the academic year. Each visit is to include:

- (i) A 20 minute presentation given to a defined group of graduate students and a limited number of faculty on a recent research article of direct relevance to the research of the PhD

student. This presentation will be followed by extensive discussion and interaction.

- (ii) Discussion of issues of mutual research interest with a minimum of three other graduate students engaged in related research at the University. These students may be within the research group of the dissertation advisor or another advisor(s).

The PhD student will submit documentation each semester to the Secretarial Coordinator of the Graduate Program, indicating satisfaction of requirements (i) and (ii). Documentation of requirement (i) will include the complete citation of the journal article that served as the basis for the 20 minute presentation and names of graduate students and faculty present. For requirement (ii), a one-page summary of the interactions with other students is required, including their names and highlights as to how the student's own research has been influenced by these discussions.