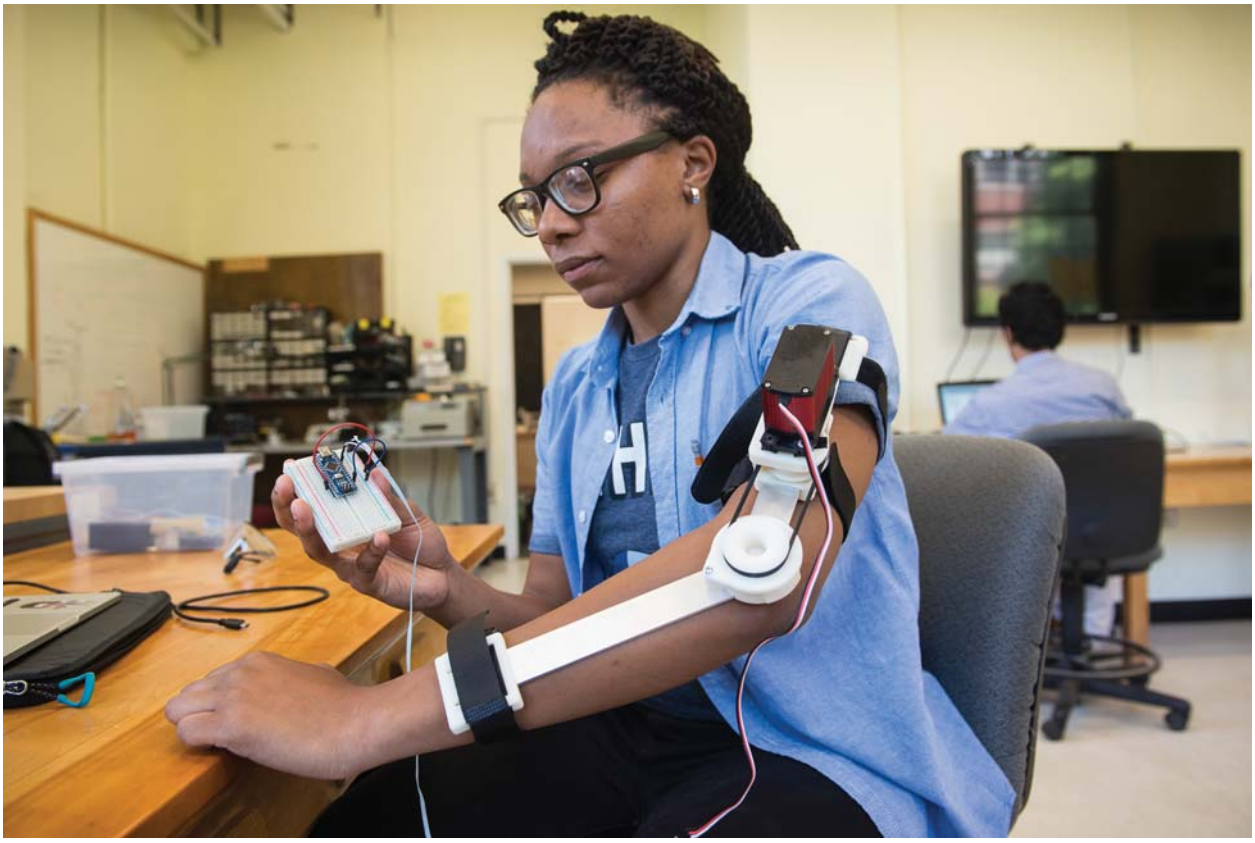
GRADUATE STUDENTS HANDBOOK

DEPARTMENT OF MECHANICAL AND INDUSTRIAL ENGINEERING

2017–2018

November 2017



Contents

1 WELCOME

We are delighted that you have decided to pursue graduate studies here at the Department of Mechanical and Industrial Engineering at the University of Massachusetts Amherst. We wish you well throughout your program of studies and encourage you to keep in close touch with your advisor and the Graduate Program Director (GPD)[1].

The purpose of this booklet is to provide graduate students and faculty with a source of information about the regulations and policies of the MIE Department regarding its graduate program. This booklet supplements information in the Graduate Catalog and in the "Graduate School Handbook" published by the Graduate School. New students should carefully read all three of these documents. IT IS THE RESPONSIBILITY OF EACH STUDENT TO SEE THAT ALL OF THE GUIDELINES SET BY THE GRADUATE SCHOOL AND THE DEPARTMENT ARE FOLLOWED. Any exception to the policy should be approved in writing by the GPD.

When questions arise which are not answered in this or one of the publications noted, students are requested to first consult with their advisors, then, if necessary, with the GPD, and finally, with the Department Head. All members of the faculty and the Department Head welcome questions or comments from graduate students on academic or personal matters.

2 THE FIRST STEP FOR NEW STUDENTS

New students should report to Dorothy Adams in the MIE Department Graduate Office (Engineering Lab 208F) for information and instructions. There is a mandatory orientation meeting for all new graduate students in the MIE Department during the first week of classes.

Students should also familiarize themselves with the obligations to acknowledge their sources in all their class and research writing. Academic integrity requires that when we use the ideas or words of previous works, we use footnotes, endnotes, or quotation marks, as appropriate. At UMass, we must abide by the Code of Conduct which explicitly forbids plagiarism.

[1]Professor Yahya Modarres-Sadeghi (10B Gunness Lab, modarres@engin.umass.edu) is the current MIE Graduate Program Director.

3 THE M.S. PROGRAMS (30 CREDITS)

3.1 Entrance Requirements

M.S. Degree Programs may be entered directly by qualified students with B.S. degrees from any engineering discipline, metallurgy or materials, physics, or mathematics. Students with degrees in other disciplines should consult the GPD for advice on preparing for graduate courses.

3.2 Course Requirements for a Master of Science Degree in Mechanical Engineering

In addition to the Graduate School requirements stated in the Graduate School Catalog, all M.S. students in the Mechanical Engineering program are required to take a minimum of four (4) MIE Core courses from the list of eight courses shown below:

- MIE 601 Advanced Thermodynamics or ChE 621 Thermodynamics
- MIE 603 Numerical Methods
- MIE 605 Introduction to Finite Element Modeling, Analysis, and Applications
- MIE 607 Advanced Fluid Dynamics I
- MIE 609 Mechanical Property of Materials
- MIE 616 Design Optimization
- MIE 641 Vibrations or MIE 643 Mechatronics
- MIE 644 Applied Data Analysis

3.3 Course Requirements for a Master of Science Degree in Industrial Engineering and Operations Research

In addition to the Graduate School requirements stated in the Graduate School Catalog, all M.S. students in the Industrial Engineering and Operations Research Program are required to take the following six courses:

- MIE 620 Linear Programming
- MIE 651 Production Planning I or MIE 697Q Logistics
- MIE 657 Human Factors Design Engineering
- MIE 684 Stochastic Processes in Industrial Engineering
- MIE 754 Economic Decision Making for Engineers II
- A graduate level course in the students area of interest approved by their advisor.

All entering M.S. students who are planning to enroll in the industrial engineering and operations research program are expected to have successfully completed courses covering the following topics: linear programming, probability and statistics, and production planning. Entering M.S. students who have not taken a course at the undergraduate level covering these topics must get permission from the instructor of a required course to enroll. The instructor, at his or her discretion, may require that the student take a prerequisite (e.g., linear algebra may be required as a prerequisite for linear programming). This prerequisite will not count for credit towards the graduate program requirements if it is an undergraduate level course. Those students who need make-up courses should expect to take at least one additional semester to complete their graduate degree.

All students are expected to attend the weekly Industrial Engineering seminar (MIE 794).

3.4 Course Requirements for a Master of Science Degree in Engineering Management

The ten-course program offers engineers the opportunity to acquire the theory, skills, and practical ideas upon which to base a strong managerial career. Electrical, Mechanical, Chemical, Civil, Industrial and all baccalaureate engineering and science degree candidates are welcome to apply. In addition, professionals with experience in engineering industries are welcome to apply for the degree program. The Master of Science program emphasizes both engineering technology and management perspectives in solving complex problems, making decisions, and managing risk within the framework of complex systems analysis and design.

The core courses required are the following:

- MIE 657 Human Factors Engineering
- MIE 697Z Introduction to Systems Engineering
- MIE 686X Multiple Criteria Decision Making & Decision Analysis
- MIE 754 Economic Decision Making
- MIE 532 Network Optimization

At least three electives must be at the 600 level or above, and two electives at the 500 level or above. Electives should be chosen in cooperation with the advisor. One elective can be satisfied by independent study. Many of the courses offered in this program are available through an on-line course program to make it very flexible for completing the degree requirements in a reasonable amount of time.

3.5 Dual Master in Business Administration and Industrial Engineering and Operations Research or Mechanical Engineering (72 Credits)

Students in the dual master program must complete the 30 credits required for a Master of Science degree in Industrial Engineering and Operations Research or Mechanical Engineering, as specified above, plus 42 credits in the Isenberg School of Management (36 credits of core MBA course requirements and an industry practicum).

3.6 Thesis Option or Coursework Only Option

Incoming students may choose one of two options for earning their Master's of Science in Mechanical Engineering or Masters of Science in Industrial Engineering and Operations Research: (1) The Thesis option or the (2) Coursework Only option. Students must declare which option they are pursuing when applying to UMass. Students are not generally permitted to switch from one option to the other; they may only switch options with the permission of the MIE Graduate Program Director.

3.6.1 Thesis Option for both ME and IEOR

All M.S. students who choose the Thesis Option are required to plan and carry out a research, design, or development thesis (MIE 699) or project (MIE 688) of nine credits, and 21 course credits.

3.6.2 Master of Science in Mechanical Engineering, Coursework Only Option

The requirements of the Coursework option are:

1. The student must successfully complete at least 30 graduate (500 level or above) credits. Thesis or project credits do not count towards this total.
2. At least 21 credits must be at the 600 level or above.
3. At least 21 credits must be Mechanical and Industrial Engineering courses.
4. A maximum of 6 credits can be for independent study.
5. The student must take four of the MIE Core courses.
6. Credits that apply to any other degree program, with the exception of graduate certificate programs,cannot be applied to this degree.

Master's students who select the coursework option will not usually be considered for assistantships or tuition waivers.

3.6.3 Master of Science in Industrial Engineering & Operations Research, Coursework Only Option

The requirements of the Coursework Only option are:

1. The student must successfully complete at least 30 graduate (500 level or above) credits. Thesis or project credits do not count towards this total.
2. At least 21 credits must be at the 600 level or above.
3. At least 18 credits must be Mechanical and Industrial Engineering courses.
4. A maximum of 6 credits can be for independent study.
5. The student must take the five named IEOR core courses required for the MS Thesis option.
6. Credits that apply to any other degree program, with the exception of graduate certificate programs, cannot be applied to this degree.

Master's students who select the Coursework Only option will not usually be considered for assistantships or tuition waivers.

3.6.4 Master of Science with a focus on Biomechanical Engineering (BME) Track

MIE graduate students in the BME track should take at least 7 courses:

Mandatory Course Requirement

- Minimum of 2 MIE courses
- Minimum of 3 BME courses offered in the College of Engineering and may be listed in different departments.
- Minimum of 2 courses from other graduate programs (e.g. Molecular & Cell Biology Program, School of Public Health and Health Sciences, amongst other departments)

The students are strongly suggested to:

- sign up for MCB seminar series
- sign up for journal clubs

Graduate students lacking background in area of study are strongly encouraged to take undergraduate courses to attain necessary didactic background. Course suggestions should be worked out with thesis advisor. Some suggestions are:

- BIO 151
- BIO 285

If the student has taken undergraduate cell & molecular biology courses, then they should take:

- 559–Cellular & Molecular Biology II Advanced Molecular Biology (MOLCLBIO/BIOCHEM 642).

Other courses to consider:

- BIO 285 Cellular & Molecular Biology -OR- BIOCHEM 275 - Molecular Biology
- MOLCLBIO/BIOCHEM 642 Advanced Molecular Biology
- BIO 559–Cellular & Molecular Biology II
- ChemE 220 Chemical Engineering Principles of Biological Systems
- ChemE 590 Microfluidics and Microscale Analysis in Materials and Biology
- ChemE 597D - Nanostructured Biomaterials
- ChemE 575 - Tissue Engineering
- MIE 597/697CM Connections in Medicine, Biology and Engineering
- MIE 597MB Orthopaedic Biomechanics
- MIE 597T Molecular, Cellular and Tissue Biomechanics

3.7 Other Course Requirements

The Graduate School requires students to graduate with a cumulative GPA of 3.0 or above. All students will need to take additional courses beyond the core courses (the total credits must reach 30). The exact number of additional courses required will depend on the number of credits that the student receives in core courses and as part of the thesis or project.

3.8 M.S. Thesis

An M.S. Thesis may be a research, design or development project. A copy of the Thesis outline must be approved by the student's committee and put on file with the GPD and forwarded to the Graduate School at least four months prior to the defense. The Thesis guidelines prepared by the Graduate School must be followed. The format for the Thesis must follow the instructions from the Graduate School Catalog and the Graduate School Handbook.

3.9 M.S. Project

An M.S. Project has the same features as the Thesis, except that its final report does not have to abide by the Graduate School formatting guidelines. As in the case of the Thesis, the candidate must obtain written approval by all members of his/her Project Committee for his/her proposed project outline. The project outline, with the cover sheet bearing the signatures of the Committee members and the date of the Project Committee's meeting with the candidate, must be forwarded to the GPD for the student's file. A copy of the final report, along with a cover sheet bearing the signatures of the committee members indicating their approval as to style and content, must

be submitted to the Graduate Program Office before the Certificate of Eligibility for a Master's Degree form may be signed by the Department Head.

The Masters project is to serve as a conduit for problem solving. It is expected to satisfy the following objectives:

- Provide the opportunity to practice methodical problem solving of viable industrial and/or technical problems,
- Foster innovation and research, and
- Provide the format to practice report writing and presentation skills.

3.10 Thesis/Project Defense

The candidate must defend his or her thesis/project. This defense is judged by the Thesis/Project Committee. A copy of the thesis/project must be given to the members of the Committee at least two weeks before the defense. The Thesis/Project committee must be approved in writing by the GPD and the defense schedule must be announced at least 7 days prior to the exam. A notice of the defense shall be sent to all MIE faculty members.

3.11 Graduation

At the end of this brochure is a checklist for the graduation process.

3.12 M.S. Timeline

The following is the suggested timeline. Some deadlines are firm; others are more flexible.

1. First Semester: Select Permanent Advisor
2. First Semester: Prepare Program of Study
3. End of First Year: Register for Thesis/Project Credit
4. End of First Year: Select Thesis/Project Committee
5. End of Second Year: Complete Required/Elective Courses
6. Four Months Prior to Defense: Thesis/Project Outline
7. Set the Date of Defense.
8. Two Weeks Prior to Defense: Deliver Thesis/Project to Committee
9. After Defense: Hand in Copy of Thesis/Project to Graduate Program Office

4 THE PH.D. PROGRAM

4.1 General Requirements

The Ph.D. program is intended to prepare the student for a research career in industry, academia or national laboratories. A dissertation, presenting significant new information, is the primary requirement of the degree. Other requirements for the Ph.D. degree include:

- A minimum of one academic year in residency. Residency is defined as one continuous academic year of full-time graduate work (9 credits per semester).
- A certification by the candidate's Guidance Committee that the candidate is qualified to pursue the Ph.D. degree.
- Successful completion of a preliminary comprehensive examination.
- An approved dissertation proposal.
- Completion of an approved course curriculum
- A Ph.D. dissertation.
- A final oral examination.

Additional University requirements are listed in the Graduate School Bulletin. Note that the MIE Department does not require a student to demonstrate competency in a foreign language.

Students considering a doctoral degree are strongly encouraged to obtain an M.S. degree in Mechanical or Industrial Engineering before attempting to establish candidacy in the Ph.D. program. Although this is not a requirement, experience indicates that previous research experience provides better preparation for Ph.D. dissertation work.

4.2 Graduate School Residency Requirement

"A doctoral candidate must spend the equivalent of at least one continuous academic year of full-time graduate work (nine credits per semester) in residence at the University. The residency year must be either in a Fall/Spring or Spring/Fall sequence. During this year, the student must spend some part of each week physically on campus."

4.3 Curricular Components for Ph.D. Degree

The minimum course requirement for the Ph.D. degree is enrollment in 18 credits of MIE 899 (Doctoral Dissertation). Ph.D. students must also formulate a complete and coherent program of coursework approved by the students Dissertation Committee and the GPD.

4.3.1 Ph.D. in ME

Approved programs must include at least 9 course credits (audited courses do not count) beyond the requirements of M.S. Degree. Only one of the required courses can be at the 500 level. These and other courses (including ones taken as part of a M.S. Degree Program) should comprise a major concentration and a minor concentration. A concentration consists of a series of at least 9 course credits. Students who do not hold a Masters degree will take a total of 30 credits which include the 9 PhD course credits.

4.3.2 Ph.D. in IEOR

Approved programs must include courses which have covered the material in the six required courses for the M.S. degree in I.E.O.R. Normally, students receiving a masters degree in MIE will have completed all required courses. Additionally, all students in the Industrial Engineering program are expected to attend the weekly seminar.

4.4 The MIE Ph.D. Preliminary Comprehensive Exam

Each Student enrolled in the Ph.D. program must pass a preliminary comprehensive exam prior to his/her fourth semester as a Ph.D. student. The purpose of the preliminary comprehensive exam, also referred to as the qualifying exam is to ensure that the student is qualified in both knowledge and critical thinking skills to pursue a Ph.D. in his/her intended field of study.

4.4.1 Administration and Registration

The Mechanical & Industrial Engineering GPD coordinates the administration of the exam.

Students notify the MIE GPD of their intention to take the exam. Students who have done so will be notified by the GPD as to the date and format of the exam.

4.4.2 Format and Scope

Each candidates exam will consist of a written exam and an oral exam. Refer to Section 7: MIE Qualifying Exam for a complete description of the four possible formats of the qualifying exam. The candidates advisor and the GPD will determine the format of each candidates exam.

The scope of the exam will be established by the candidates examining committee and the GPD to test general knowledge and critical thinking skills in the candidates intended area of study.

4.4.3 Outcomes

The three possible outcomes of the exam are: Pass, Conditional Pass, and Fail. A Conditional Pass indicates that the examination committee and the GPD have concluded that the student is qualified to pursue a Ph.D., provided that the student improves his/her knowledge and skills in one or more specific areas. In those cases, the examination committee and the GPD will specify a remedial course of action intended to address the weakness identified from the preliminary comprehensive exam. The remediation plan can include, but is not limited to course work, independent study projects and subsequent focused examination. A grade of Conditional Pass shall be converted to Pass upon successful completion of the remediation plan within the specified time period. Otherwise, Conditional Pass will be automatically converted to Fail.

A student who has failed in his/her first attempt to pass the preliminary comprehensive exam may petition the Graduate Program Committee to retake the exam.

4.5 MIE Ph.D. Dissertation

After successful completion of the preliminary comprehensive examination, the GPD shall recommend to the Dean of the Graduate School the names of at least three members of the graduate faculty to serve as the dissertation committee. The dissertation committee shall consist of at least three members of the graduate faculty including an outside member (as defined by the Graduate School) and at least two regular MIE faculty members.

The Ph.D. candidate submits a dissertation proposal to each member of the dissertation committee. The candidate makes an oral presentation of his/her proposal at a meeting of the dissertation committee, and upon unanimous approval by the committee, a copy of the proposal signed by all members shall be submitted to the Dean of the Graduate School. This copy shall be accompanied by a request for formal appointment of the dissertation committee by the Graduate School. This action must take place at least seven months prior to the final oral examination.

When all members of the dissertation committee have approved a draft of the dissertation, the final oral examination may be scheduled. See the Graduate School Handbook for scheduling regulations. Notice of the final oral examination must be given to all MIE faculty at least seven days prior to the exam.

The final oral examination is primarily, but not necessarily, limited to a dissertation defense. The examination will be conducted by the candidate's dissertation committee (all members of which must be present). To pass, the candidate must receive the unanimous vote of the dissertation committee. All other graduate faculty members are encouraged to attend, but with non-voting status. Two negative votes shall fail the examination. A single negative vote will result in the degree being held in abeyance pending review and action by the Graduate Council of the Graduate School.

See the Graduate School Handbook for detailed regulations on preparation and submission of the dissertation copies, payments of fees, etc.

4.6 Other Requirements and Procedures applicable to all PhD students

New Ph.D. students who are not committed through a GRA to a specific faculty member for research will be assigned the GPD as a Temporary Advisor until a Dissertation Committee Chairperson has been determined. Students are urged to begin as soon as possible to explore dissertation research topics with the faculty.

- Graduate students are encouraged to attend the Departmental Seminar Series regularly.
- It is expected that Fellowship and Assistantship holders will devote full time to their studies and will not hold other part-time jobs or be simultaneously enrolled in another degree program. Students not supported by the Department or University are required to notify their advisor and the GPD of any part-time employment.
- In addition to other required copies, a final copy of the Dissertation must be given to the Department Head for the Department records.

4.7 Ph.D. Timeline

The following is the suggested timeline.

1. First Semester: Select Permanent Advisor
2. First Semester: Prepare Program of Study
3. End of First Year: Register for Dissertation Credits
4. End of First Year: Select Dissertation Committee
5. End of Second Year: Take Comprehensive Exam
6. AT LEAST Seven Months Prior to Defense: Dissertation Outline (2 years after the start for students without MSc, 1.5 years after the start for students with MSc)
7. Notify Graduate Program Office of Defense Date
8. After Defense: Hand in Copy of Dissertation to Graduate Program Office

5 GENERAL INFORMATION FOR THESIS-OPTION MS AND ALL PHD STUDENTS

5.1 Other Requirements and Procedures

1. Students must ideally select a permanent thesis advisor before registering for classes for the first time. A student arriving with support in the form of a research assistantship will have his/her project director as his/her thesis or project committee chairperson and also his/her advisor. Other students with fellowship support or teaching assistantship or non-supported students should find a permanent thesis/project advisor within two months and in no case later than the end of their first semester. The GPD may act as a temporary advisor for new students who have not yet found a permanent advisor before first time registration. Registration must always have the approval of the student's advisor.

   General information about the faculty and their research interests can be found on the Departments website.
2. Students are expected to prepare a coherent program of study during the first semester and before pre-registration for the second semester. This program of study should be approved by the students advisor in consultation with the members of his/her M.S. committee. Curriculum programs which deviate from requirements specified herein must be approved in writing by the GPD and recorded on the student's curriculum form. The M.S. Thesis or Project Committee members are selected by the student with advice and approval of the Committee Chairperson and the GPD. The Committees shall consist of three members of the Graduate Faculty, at least two of whom must be regular MIE faculty and at least one of whom must be outside the immediate area of specialization of the thesis or project. Thesis and project committee members must agree to serve before they are appointed to the committee.
3. Advisors will normally require that students register for three credits of Thesis or Project in their first or second semester. Teaching Assistants may not register for more than a total of thirteen credits per semester.
4. A copy of a thesis outline or project proposal must be approved by the student's committee and must be put on file in the Department office at least four months prior to the Thesis or Project defense. The thesis outline must also be put on file in the Graduate School Office (see the Graduate School Handbook).
5. In addition to other required copies, a bound copy of the final project report must be given to the Department Head for the Department records. Bound copies of the final thesis or dissertation are no longer required since electronic copies are available through the library. Binding specifications are available at the Graduate Program Office.
6. ASSISTANTSHIP AND FELLOWSHIP HOLDERS ARE NOT PERMITTED TO HOLD OTHER PART-TIME JOBS OR TO BE SIMULTANEOUSLY ENROLLED IN ANOTHER DEGREE PROGRAM WITHOUT THE WRITTEN PERMISSION OF THEIR ACADEMIC ADVISOR AND THE GPD. Students not supported by the Department or University are required to notify their advisors and the GPD of any part-time employment.

5.2 Role of the Graduate Committees

The MIE Graduate Committee, chaired by the GPD, administers all MIE Graduate Degree Programs. Subject to final approval by the Department Head, the Graduate Committee is responsible for all aspects of the graduate programs and approves plans of study, Dissertation Committee appointments, recommendations for degrees, etc. The committee also administers the Preliminary Comprehensive (Qualifying) exam for students obtaining their Ph.D. degree in Mechanical and Industrial Engineering. Advisors and Dissertation Committees are subordinate to the Graduate Committee though it is rare that the recommendations of the Advisor and Dissertation Committee are not accepted.

5.3 Graduate Teaching Assistants

Subject to the availability of qualified applicants, all graduate teaching assistantships (GTAs) are initially offered to new incoming graduate students. Graduate teaching assistantships are offered not only to fulfill immediate departmental needs, but also to advance the degree programs of graduate students and the teaching needs of the Department. Students who have appointments as GTAs will be assigned duties and a faculty supervisor by the Department Head. This work will normally require between 15 and 20 hours of work each week. It is the policy of this Department not to renew teaching assistantships beyond the time period stated in the initial contract. All additional financial support is generally provided by a student's academic advisor, or through fellowships.

5.4 Graduate Research Assistants

All applicants for admission to the graduate program in MIE are automatically considered for teaching and research assistantships in the Department. Each applicant's qualifications are first reviewed by the Graduate Committee. The Graduate Committee then submits the application forms for the top candidates for further review by individual faculty members whose interests most closely parallel those of the applicants. The decision to offer a research assistantship is made by individual faculty members and is based upon the availability of funds and the qualifications of each applicant. The stipends received for this work vary with the type of work, the amount of time involved and the availability of funds. These details are normally worked out between the student and his project director and generally exclude the possibility of the student taking any part-time or full-time consulting jobs.

The topic or program of the GRA work will usually coincide with that of the student's thesis, dissertation, or project, so the project director will automatically assume the role of the students advisor as well.

Continuation of the research assistantship is based upon the continued availability of funds and satisfactory performance by the student in both research and course work.

Graduate students who are already in the program and who do not have a research assistantship are encouraged to contact individual faculty members whose interests closely parallel those of the student and inform them of their interests and availability. The decision to offer an assistantship to a student always rests with the faculty member.

6 DEGREE COMPLETION PROCEDURE

For timely completion of degrees, it is essential that all of the Graduate Schools policies and deadlines are followed. The forms need to be completed and those to be submitted to the Graduate School need to have original signatures in black ink It is important to note that a committee is not official until recommended by the GPD and appointed by the Graduate School. Also of particular importance is to have an approved copy of the thesis/dissertation outline on file with the Graduate school 4 months prior to the MS thesis defense and 7 months prior to the final PhD oral exam The Graduate School will not allow a defense to be scheduled if the above timeline is not followed.

IT IS THE STUDENT'S RESPONSIBILITY TO SEE THAT ALL MEMOS AND FORMS ARE SENT TO THE DEPARTMENT AND THE GRADUATE SCHOOL.

6.1 M.S. Programs

The student should obtain a Masters Graduation Eligibility Form from the Graduate Schools website at www.umass.edu/gradschool under Policies and Forms. This form should be completed and submitted to the Graduate Program Office (ELAB 208F) for approval. Please note that this form will only be accepted upon approval of the original M.S. Thesis or Project by all committee members.

6.2 Ph.D Program

The procedure parallels the M.S. program above. The Graduate School requires additional forms to be completed by the candidate. These forms are listed on the Checklist for Doctoral Degree under Policies and Forms.

7 PHD QUALIFYING EXAM

Effective for all students entering after 5/31/2016

7.1 Exam Timing

Currently, the MIE Department has three different pathways available for pursing a PhD degree: direct entry into a PhD program with a bachelor degree, entry into a PhD program with a UMASS MS degree, entry into the PhD program with a non-UMASS MS degree. The timing of the qualifying exam for each of those cases is described in detail below.

1. Direct Entry into the PhD Program - Every full-time student in the Department's PhD direct admission pathway is required to take the qualifying exam within two calendar years after his or her entry into the program.
2. Entry into the PhD Program with a UMASS MS Degree - Every full-time student in this pathway is required to take the exam within one and a half calendar years after his or her entry into the Ph.D. program.
3. Entry into the PhD Program with a non-UMASS MS degree Every full-time student in this pathway is required to take the exam within one and a half calendar years after his or her entry into the Ph.D. program.
4. Part-Time Students Part-time students are advised to take the exam when 18 credits of course work have been completed or within two years after their entry into the PhD program, whichever occurs first.
5. Transferred Students Occasionally, students who have passed a qualifying exam at a PhD granting institution transfer into the UMASS PhD program. In this case, the students may file a petition to the Graduate Program Director to waive or to defer the qualifying exam. Please note that the petition may or may not be granted.

7.2 Exam Format

The exam is typically given twice yearly, normally during months of January and May. Any student who intends to take the exam is required to notify their research advisor. It is the responsibility of student and his or her research advisor to coordinate the administration of the exam. The examination committee will consist of a minimum of three faculty members; with at least two MIE faculty members. No outside member is required on the examination committee; however, faculty members outside of MIE can serve as additional members of the examination committee.

The exam has a written component and an oral component. Details of these components will be decided by the students research advisor in consultation with the examination committee. Although, no standard format is required across all research groups, the following formats have been deemed acceptable. Note that choosing the written component of one qualifying exam format and the oral component of another will also be deemed acceptable.

7.2.1 Qualifying Exam Format A

- Written Component - The written component will last three hours and consist of two or more questions in the students declared major interest area. Questions will be designed to be similar in content and difficulty to an exam question given in a 600-level course within the students major interest area. The written component may be open or closed book. The examining committee will notify the student as to the written exam format prior to administration of the written exam.
- Oral Component - The oral component consists of one or more open-ended questions related to the student's chosen major interest area. The oral exam will be given to each student individually and will be taken within the two weeks following the written exam. The student will be granted anywhere from one hour to one week to prepare their response to the exam questions. The oral component of the qualifying exam will be administered by the examining committee and will normally last one hour. The examining committee will notify the student as to the oral exam format prior to administration of the oral exam.

7.2.2 Qualifying Exam Format B

- Written Component - The written component will last three hours and consist of two or more questions in the students declared major interest area. Questions will be designed to be similar in content and difficulty to an exam question given in 600-level course within the students major interest area. The written component may be open or closed book. The examining committee will notify the student as to the written exam format prior to administration of the written exam.
- Oral Component - The oral component will consist of a research presentation of the students research work to the examining committee. The research presentation will last thirty minutes to an hour and include a detailed literature review of previous work, a description of the methodology used in the research, and an overview of the work performed by the student to date. Questions on the students research work as well as related areas such as the engineering relevance of the work can be asked by the examination committee. The research presentation will be given within two weeks following the written exam.

7.2.3 Qualifying Exam Format C

- Written Component The student will be given one or more peer-reviewed journal articles in their declared major interest area to read and review. The student will have one to two weeks to read the articles and write a critical review of the articles which analyzes the authors methods, results, conclusions, and writing style/clarity. The student will be expected to go beyond the assigned articles to other sources including textbooks and other journal articles to support his or her review. The papers to be supplied will be determined by examining committee in consultation with the students research advisor.
- Oral Component - The oral component will consist of an oral presentation of the paper review to the students examination committee. The paper review presentation will last thirty minutes to an hour. Questions on the students written review and oral presentation as well as other areas related to the assigned paper can be asked by the examination committee. The research presentation will be given a week following the submission of the written component.

7.2.4 Qualifying Exam Format D

- Written Component The student will be given three or more questions from the students declared major interest area. The student will have one to two calendar weeks to complete the questions and provide a detailed written response to his or her examination committee. The questions can range from a hard homework question with a well-defined answer to an open-ended research question.
- Oral Component In collaboration with the examination committee, the student will prepare a set of approximately twenty questions to be researched and answered by the student in preparation for the oral exam. The questions are intended to be factually based and not additional exam problems to solve. The oral component of the qualifying exam will consists of one or more rounds of questions from the examining committee based either directly on the twenty questions or on an extension of the written exam questions. The oral component of the qualifying exam will normally last one hour.

8 GUIDELINES FOR COURSE SELECTION

M.S. Degree Students

For an MS degree in the Mechanical and Industrial Engineering Department (MIE) a minimum of 30 credits are required. For an MS Thesis student, up to 9 credits of thesis can be taken and counted towards the 30 credits needed for graduation. For an MS Course Work Only student, up to 6 credits of independent studies can be taken.

All M.S. students in the Mechanical Engineering Program are required to take a minimum of four MIE courses from the list of eight courses shown below:

- MIE 601 Advanced Thermodynamics or ChE 621 Thermodynamics
- MIE 603 Numerical Methods
- MIE 605 Introduction to Finite Element Modeling, Analysis, and Applications
- MIE 607 Advanced Fluid Dynamics I
- MIE 609 Mechanical Property of Materials 4
- MIE 616 Design Optimization
- MIE 641 Vibrations or MIE 643 Mechatronics
- MIE 644 Applied Data Analysis

All M.S. students in the Industrial Engineering and Operations Research Program are required to take the following five courses:

- MIE 620 Linear Programming
- MIE 651 Production Planning I or MIE 697Q Logistics
- MIE 657 Human Factors Design Engineering
- MIE 684 Stochastic Processes in Industrial Engineering
- MIE 754 Economic Decision Making for Engineers II
- A graduate level course in the students area of interest approved by their advisor.

All M.S. students in the Engineering Management Program are required to take the following five courses:

- MIE 657 Human Factors Engineering
- MIE 697SEI Introduction to Systems Engineering
- MIE 686 Multiple Criteria Decision Making & Decision Analysis
- MIE 754 Economic Decision Making
- MIE 532 Network Optimization

In addition to the required courses listed above, several courses are available to complete the required 30 credits. A number of possible elective courses are listed along with the approximate frequency with which they are offered. This list consists of both courses that are offered in MIE and courses offered in some other Departments/Colleges across campus.

8.1 Topic Area: Fluid Dynamics and Wind Energy

8.1.1 Fall (Approximate Frequency)

- MIE 551 Thermal Environmental Engineering (Once every two year)
- MIE 573 Engineering Windpower Systems (Every Year) and online
- MIE 601 Advanced Thermodynamics (Every year)
- MIE 603 Advanced Numerical Analysis (Every year)
- MIE 607 Advanced Fluid Mechanics (Every year)
- MIE 697FS Fluid-Structure Interactions (Once every two years)
- ChE 633 Transport Process
- CEE 670 Transport Processes in Environmental and Water Resources
- Physics 850 Soft Condensed Matter Physics

8.1.2 Spring (Approximate Frequency)

- MIE 570 Solar and Direct Energy Conversion (Every year)
- MIE 604 Computational Fluid Dynamics (Once every two years)
- MIE 605 Finite Element Analysis (Every year)
- MIE 673 Wind Turbine Design (Once every two years)
- MIE 674 Offshore Wind Energy Systems (Once every two years)
- MIE 701 Advanced Thermodynamics (Once every two years)
- MIE 707 Viscous Fluids (Once every two years)
- MIE 821 Turbulence (Once every two years)
- CEE 662 Water Resource Systems Analysis
- CEE 561 Open Channel Flow
- CEE 560 Hydrology
- PHYS 553 Optics-With Lab

8.2 Topic Area: Design and Bioengineering

8.2.1 Fall (Approximate Frequency)

- MIE 573 Engineering Windpower Systems (Every year) and online
- MIE 597MB Molecular Cellular and Tissue Biomechanics (Every year)
- MIE 603 Advanced Numerical Methods (Every year)
- MIE 609 Mechanical Properties of Materials (Every year)
- MIE 616 Engineering Design Optimization (Once every two years)
- MIE 630 Advanced Solid Mechanics (Every year)
- MIE 657 Human Factors Engineering (Every year)
- MIE 697R Biorobotics (Once every two years)
- KIN 530 Mechanical Analysis of Human Movement (Every year)
- KIN 797U Computer Simulation of Human Movement (Every year)

8.2.2 Spring (Approximate Frequency)

- STAT 506 Design of Experiments (Every year)
- MIE 597G Mechatronics (Once every two years)
- MIE 597W Adaptive and Nonlinear Control (Once every two years)
- MIE 597SM Skeletal & Tissue Biomechanics (Once every two years)
- MIE 605 Finite Element Analysis (Every year)
- MIE 655 Quality Control and Reliability (Every year)
- MIE 673 Wind Turbine Design (Once every two years)
- MIE 686 Multiple Criteria Decision Making & Decision Analysis (Every year)
- KIN 535 Muscle Mechanics (Every year)
- CMPSCI 603 Robotics (Every year)

8.3 Topic Area: Dynamics and Controls

8.3.1 Fall (Approximate Frequency)

- MIE 697FS Fluid-Structure Interactions (Once every two years)
- MIE 697L Nonlinear Dynamics (Once every two years)
- MIE 697R Biorobotics (Once every two years)
- CEE 615 Probabilistic Methods in Structural Mechanics
- MATH 532H Nonlinear Dynamics and Chaos with Applications
- ECE 580 Feedback Control Systems
- MIE 645 Advanced Des. Feedback Sys.
- PHYSICS 860C Monte Carlo Techniques

8.3.2 Spring (Approximate Frequency)

- MIE 605 Introduction to Finite Element Modeling, Analysis, and Applications (Every year)
- MIE 641 Vibrations (Once every two years)
- MIE 644 Applied Data Analysis (Once every two years)
- MIE 597G Mechatronics (Once every two years)
- MIE 597W Adaptive and Nonlinear Control (Once every two years)
- CMPSCI 603 Robotics (Every year)
- CEE 541 Structural Dynamics

8.4 Topic Area: Materials Engineering

8.4.1 Fall (Approximate Frequency)

- MIE 597MM Metamaterials (Every two years)
- ChE 621 Thermodynamics I (Every year)
- MIE 603 Advanced Numerical Analysis (Every year)
- MIE 609 Mechanical Properties of Materials (Every year)
- MIE 630 Advanced Solid Mechanics (Every year)
- MIE 697PO Photonics and Optical Engineering (every two years).
- POLYMER 797EM Electron Microscopy (Every year)
- POLYMER 897F Surface & Interfacial Mechanics (Every year)
- PHY 850 Soft Condensed Matter Physics

8.4.2 Spring (Approximate Frequency)

- MIE 571 Physical and Chemical Processing of Materials (Every year)
- MIE 579 Advanced Materials Engineering (freq. TBD)
- MIE 597E Computational Materials Science (freq. TBD)
- MIE 597MC Advanced Materials Characterization
- ChE 597D Nanostructured Biomaterials
- ChE 622 Thermodynamics II (Every year)
- MIE 605 Finite Element Analysis (Every year)
- PHY 558 Solid State Physics (Every year)
- POLYMER 501 Introduction to Polymer Science & Eng (Every year; has prereqs.)

8.5 Topic Area: Industrial Engineering and Operations Research

8.5.1 Fall (Approximate Frequency)

- MIE 620 Linear Programming (Every year)
- MIE 657 Human Factors Engineering (Every year)
- MIE 697SEI Introduction to Systems Engineering (Every year)
- MIE 686 Multiple Criteria Decision Making & Decision Analysis (once every three years)
- MIE 532 Network OptimizationSCH-MGMT 752x: Deterministic Models (Every year)
- SCH-MGMT 758 Supply Chain Management (Every other year)
- SCH-MGMT 797SS Quantitative Analysis in Supply Chain Ops. (frequency unknown)
- SCH-MGMT 670 Operations Management (Every year)

8.5.2 Spring (Approximate Frequency)

- MIE 651 Production Planning I (Every other year)
- MIE 697Q Logistics (Eevery year)
- MIE 684 Stochastic Processes in Industrial Engineering (Every year)
- MIE 754 Economic Decision Making for Engineers (every year) and online
- STAT 506 Design of Experiments (Every year)
- MIE 597 C Operations Research in Healthcare (Every other year)
- SCH-MGMT 597LG Humanitarian Logistics and Healthcare (Every other year)
- SCH-MGMT 825x Integer Programming (Every other year)
- SCH-MGMT 797AE Stochastic Models (Every year)

8.6 Topic Area: Biomechanical Engineering

8.6.1 Fall (Approximate Frequency)

- BIOLOGY 559 Cellular & Molecular Biology II
- MOLCLBIO 642 Adv Moleculr Biology
- BIOLOGY 559 Cellular & Molecular Biology II
- CHEM-ENG 575 Tissue Engineering
- MIE 597MB Special Topics- Molecular, Cellular and Tissue Biomechanics

8.6.2 Spring (Approximate Frequency)

- CHEM-ENG 589 Nanostructured Biomaterials
- CHEM-ENG 590E Microfluidics and Microscale Analysis in Materials and Biology
- CHEM-ENG 575 Tissue Engineering
- MIE 597/697CM Connections in Medicine, Biology and Engineering