

HANDBOOK FOR STUDENTS

in

MECHANICAL ENGINEERING GRADUATE PROGRAMS

Version March 2024





**Department of
Mechanical &
Industrial Engineering**

Dear Graduate Student,

We are pleased that you have chosen the ME Graduate Program and Montana State University! We don't mind sharing that we have great expectations for our graduates, and endeavor to inspire their superior performance. If you have already been accepted into the program, congratulations and keep up the good work!

This handbook provides guidelines for our program in terms of philosophy, policies, and procedures. The information will benefit you greatly. We encourage you to do your best, and we promise you will be well satisfied with your program when you finish. You should also check the Graduate School website for further details or updates to policies and procedures.

So welcome! If you have any further questions, the staff in the MIE office can direct you to the right faculty member.

Sincerely,

Your Faculty Friends in Mechanical Engineering
Montana State University-Bozeman

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Mountains & Minds

INTRODUCTION

Your performance record indicates that you have the ability to handle graduate work. However, you will be challenged! The work will be harder and you must depend on your own initiative. Nonetheless, the work will be more interesting, and you will have more options. You will discover new and exciting things that will contribute to your career development. Take advantage of seminars, talks, short courses, and other activities coming your way. Also, take time to enjoy the surroundings; we live in one of the most beautiful places on earth.

One of the first things you should think about once you arrive is forming your graduate committee. The graduate committee advises the student on academic matters and is the examining committee for the comprehensive examination and dissertation defense. Your graduate committee typically includes three faculty members for an MS degree or four faculty members for a PhD degree. These faculty members should have interest and expertise in your areas of study. You must personally ask each professor if they are available and willing to serve on your committee. As part of this committee, you will have a major advisor (professor) who serves as committee chair. The committee chair should be someone with expertise in your area of emphasis and with whom you expect to have major contact through your course work. Committee membership must be approved by the department head and the Dean of Graduate Education. You can ask a larger number of faculty members to be on your committee, but you should be aware that this may result in scheduling issues, as all your committee should be present for your comprehensive exam and your dissertation defense.

IMPORTANT CONTACTS

Graduate School: <http://www.montana.edu/gradschool/>

Forms Necessary for Graduate Education: <http://www.montana.edu/gradschool/forms.html>

International Programs:

http://www.montana.edu/gradschool/admissions/international_admissions.html

English Language Academic Preparation: <http://catalog.montana.edu/special-academic-opportunities/>

English Writing Center: <http://www.montana.edu/writingcenter/>

ME Graduate Coordinators

Sarah Codd	Mechanical Engineering PhD Coordinator
Stephen Sofie	Materials PhD Coordinator
Doug Cairns	Mechanical Engineering MS Coordinator

ACADEMIC REQUIREMENTS FOR THE MECHANICAL ENGINEERING GRADUATE PROGRAMS

All students (regardless of previous degree) must have a background in mathematics equivalent to M 171 (Calc I), M 172 (Calc II), M 273 (Multivariable Calc) and M 274 (Differential Equations), a background in physics equivalent to PHSX 220 (Physics I), PHSX 222 (Physics II), a background in Chemistry equivalent to CHMY 141 (Chem I) and a background in computer methods equivalent to EMEC 203

The following courses in mechanical engineering basics are required for graduate students entering the mechanical engineering master's program without a previous degree completed in Mechanical Engineering.

Engineering Science: *EGEN 201 (Statics), *EGEN 202 (Dynamics), EGEN 205 (Strength of Materials), EGEN 335 (Fluids), EMEC 320 (Thermo I), EMEC 326 (Heat Transfer) Materials: *EMAT 250 (Intro. Materials course)

Engineering Design: EMEC 341 (Design of Machine Components), EGEN 310 (Intro. Engineering Design)

Engineering Laboratory: *EMEC 360, *361 (Mechanical Engineering Laboratory)

Depending on the previous undergraduate degree program, students may have already satisfied many of these requirements with other “equivalency” courses. i.e. students with a prior BS in Physics would not be required to take the courses with a *.

It may be possible to take some graduate courses while completing these undergraduate requirements.

GRADE REQUIREMENTS

Graduate students must maintain a cumulative average of B (3.0) or better overall courses listed on their graduate Program of Study (see below) in order to retain graduate standing. Only grades of C- or better will be counted toward the plan of study. Grades lower than C- mean the course must be repeated. The student may be placed on probation at the discretion of the student's committee and/or the Graduate School. Continued poor performance will result in dismissal from the Graduate School.

TRANSFER OF CREDITS

The student may receive transfer credits (up to the limit allowed by the Graduate School and if approved by the graduate student's committee and the Graduate School.

THE MASTER OF SCIENCE PROGRAM

Three Master's degree plans are offered in Mechanical Engineering. The two terminal Masters degrees are the Masters of Science Plan A (Thesis) which leads to a research and design oriented degree requiring a 10-credit thesis and the Masters of Engineering (Non-Thesis) which requires only coursework. The Masters of Science Plan A (non-thesis) is only available for students enroute to a PhD in Mechanical engineering.

PLAN A – THESIS

Plan A requires the student to research and write a Master's thesis as a major component of the degree program. Since research may not follow a prescribed timetable, it may be necessary to extend your stay until it is completed (i.e., it's difficult to say when you'll be done).

DEGREE REQUIREMENTS

30 Credits total to include:

- EGEN 505: Advanced Engineering Analysis I (3 cr)
- EGEN 506: Numerical Solutions to Engineering Problems (3 cr)
- EM 525: Continuum Mechanics (3 cr)
- EMEC594: Seminar (1 Cr)

Plus, 3 Graduate course credits outside the student's emphasis:.

Thesis: EMEC590 (10 Cr)

The remaining 7 credits must be 400 and 500-level courses. No pass/fail credits will be counted towards the degree.

For Plan A the comprehensive examination is the thesis defense.

Note: A maximum of 9 credits of 400-level courses can be applied to the Program of Study. Any 4XX course used for the undergraduate degree or not reserved for the graduate degree is not allowed on the Program of Study. 100, 200, or 300-level courses are not eligible to be applied toward the MS degree.

ELECTING AN ADVISOR

Students must definitely have an advisor identified by the end of the second semester, but it is recommended that they identify an advisor during their first semester in the program.

FORMULATING A MS GRADUATE PROGRAM OF STUDY

The Program of Study formalizes the student's Master's Committee and the courses to be taken for the degree. The coursework identified on the Program must meet all of the degree requirements stated above plus any additional requirements of admission or of the Doctoral Committee. The Master's student must have an approved Program of Study on file by the end of their second semester.

THESIS DEFENSE AND COMPREHENSIVE EXAM

It is the responsibility of the student to ensure the format and delivery of the written thesis satisfies the requirements of the committee and the Graduate School. Thesis writing manuals are available at the MSU Bookstore and additional assistance for all graduate students for writing skills is available through the *MSU Writing Center*.

Plan A candidates must “defend” their thesis as part of the comprehensive examination. A draft of the thesis must be submitted to the student’s graduate committee at least two weeks before the examination, to allow time for reading by the graduate committee. At the thesis examination, the candidate will make an oral presentation on the thesis in a seminar format open to the public. This will be followed by a closed-examination where only committee members ask questions of the candidate on topics pertaining to the thesis.

The candidate must (1) schedule a minimum **two-hour block** of time at least 14 calendar days before the last day of classes of the final term for his or her presentation and comprehensive oral exam, (2) reserve a room and equipment, and (3) notify the committee.

PLAN B - NON THESIS

The Plan B option has the same course requirements as listed above for the Plan A option except the Plan B option requires the substitution of a submitted journal paper or conference research presentation (3-4 credits EMEC575) and additional coursework in lieu of the 10 thesis credits and seminar credit. This option is reserved for students enroute to a Ph.D. Students seeking a terminal non-thesis Master’s degree in mechanical engineering are able to pursue the Master of Engineering Degree in Mechanical Engineering. For Plan B the comprehensive exam is the PhD qualifying exam

THE MASTERS OF ENGINEERING PROGRAM

The Master of Engineering Degree in Mechanical Engineering is a coursework only degree that allows students to acquire a Master's degree by taking 30 course credits.

In contrast to existing Master of Science which can lead to Ph.D. programs, the M. Eng. degree is the terminal degree for practicing professionals. This degree program will serve a recognized need for post-baccalaureate education for engineers and satisfy the proposed requirement for 30 credits post-graduation for professional licensure (P.E.).

PROGRAM DETAILS

Several major curricular/program components distinguish the M. Eng. from the M.S. degree:

- No professional paper or thesis is required for the M. Eng:
- The M. Eng. has no comprehensive examination:
- Students will be supervised by the Mechanical Engineering M.S. coordinator, not by a three- member committee typical for the M.S. degree.

COURSE REQUIREMENTS

30 Credits total to include:

- EM 525: Continuum Mechanics (3 cr)
- Plus, a Mechanical Engineering course in each of the following areas:
- Advanced math, statistics or numerical methods (3 cr)
 - Materials (3 cr)
 - Thermo/Fluids (3 cr)
 - Solid Mechanics (3 Cr)

The remaining courses must come be 400 and 500-level courses approved by the mechanical engineering M.S. coordinator. No pass/fail credits will be counted towards the degree.

In addition:

- At least 18 of the total credits required for degree must be at 5xx level
- 3xx and lower level courses are not allowed
- 4xx level courses may be used
- Courses with grades below C- cannot be used to satisfy graduation requirements
- Three credits (min.) registration required during term of graduation (1 credit with in absentia graduation request on file)
- A maximum of six credits of individual problems courses (592) are allowed

THE MECHANICAL ENGINEERING Ph.D. PROGRAM

The PhD program is intended to prepare students for a research career in academia or industry.

Students in the Ph.D. program must identify an advisor as soon as possible after acceptance into the program.

DEGREE REQUIREMENTS

To satisfy the requirements for the Ph.D. in Mechanical Engineering, the student will take a minimum of 60 credits beyond the bachelor's degree according to the table below.

For students entering with a Masters degree, up to 24 graded credits may be applied (see below). However, the EGEN 694 and ENGR 610 requirements and a minimum of 13 additional graded course credits must still be taken at Montana State University. Students have the option (with approval of the student's graduate committee) of using some of their M.S. credits toward any of the course requirements listed below. Credits applied from a prior Masters degree must:

- be graded course credits (e.g., not M.S. thesis or independent study credits),
- have a grade of B or higher (or equivalent), and
- be approved by the student's graduate committee.

ENGR694 should be taken the semester prior to scheduling the comprehensive exam as this seminar class helps the student to prepare the written proposal for their comprehensive.

ENGR694	Seminar (Comprehensive Exam Preparation)	2
EGEN 505	Advanced Engineering Analysis	3
EGEN 506	Numerical Sol to Engr Problems	3
EM 525	Continuum Mechanics	3
	Thermo-fluids Mechanics	3
	Solid Mechanics	3
	Other Graded Courses	15
	Dissertation	18
	Additional Dissertation or Course Credits	10
Total		60

A maximum of six credits of independent study EIND592 or EMEC592 may be applied to a PHD Degree. Independent study credits cannot be substituted for other 500 level requirements. Form 5, *Request for Offering Graduate Individual Problems* (<http://www.montana.edu/gradschool/forms.html>) must be completed by the student and approved by the department head along with the written proposal (developed with the advisor) before you will be permitted to register.

ELECTING AN ADVISOR

As part of the application process, Ph.D. students often have an identified advisor before acceptance into the program, and must definitely have an advisor identified by the end of the third semester.

DOCTORAL COMMITTEE

The advisor serves as the chair of the student's Doctoral Committee. To prepare the Program of Study, the student should meet with his/her advisor and decide (1) on the remaining membership of their graduate committee composition, and (2) the courses that will be taken to satisfy the requirements.

The Doctoral Committee composition must conform to Graduate School regulations (ie: a minimum of four members with at least two members from the MSU Mechanical Engineering faculty). The student and advisor choose the additional committee members, subject to approval of the Graduate School.

The Doctoral Committee advises the student on academic matters, approves the program of study and is the examining committee for the comprehensive examination and dissertation defense.

For a PhD thesis, the dissertation should show student independence in the development and implementation of the research as well as a higher standard of originality and significance to justify to publication in high-tier journals within the relevant field.

FORMULATING A PROGRAM OF STUDY

The Program of Study formalizes the student's Doctoral Committee and the courses to be taken for the degree. The coursework identified on the Program must meet all of the degree requirements stated above plus any additional requirements of admission or of the Doctoral Committee. The PhD student must have an approved Program of Study on file by the end of their third semester.

MATRICULATION

The Ph.D. student is considered to have "matriculated" once all the requirements for full admission have been satisfied. Normally, this means successfully completing the undergraduate courses (if any) as specified in the admission letter.

EXAMINATION REQUIREMENTS

General information about forms required for completion of examinations can be found on The Graduate School's website at http://www.montana.edu/gradschool/forms.html#forms_etd.

Ph.D. candidates in Mechanical Engineering at Montana State University must pass a qualifying examination, a comprehensive examination, and a defense of dissertation.

QUALIFYING EXAMINATION

The purpose of the qualifying examination is to determine whether the student has sufficiently mastered the core topics within their chosen area of study. It will be a written examination on undergraduate engineering topics administered by faculty in the Mechanical Engineering program.

The qualifying examination will be completed within three semesters but typically within two semesters of matriculation into the Ph.D. program. Failure to take the examination in that time period may result in suspension of Ph.D. candidate status, including stipend.

If the student fails the exam the first time, a second opportunity shall be granted within 60 days of the first attempt but no less than two weeks following the first attempt. If the student fails the second attempt, the student shall be dropped from the program. The Graduate coordinator will document the results of the examination in a letter to the student, their advisor, and in the student's file.

Mechanical Engineering Qualifying Examination: The exam will be administered on the second Tuesday in February of the Spring semester. The undergraduate Mechanical Engineering topics will include: Thermodynamics, Heat (energy) transfer, Fluid Mechanics, Structural Mechanics, Materials, Dynamics and Vibrations, and Mathematics. Students will solve problems in 4 of the 7 topic areas. The exam will be 5 hours duration in an open book, open notes format. Each problem set will be graded by the faculty member that submitted the set. The results will be analyzed by the Mechanical Engineering graduate studies committee, and each candidate will receive a grade of Pass (P), Fail (F) or Remediate (R). Students will not be given the test back in order to protect the questions from dissemination. In cases where remediation in certain topic areas is required, the Ph.D. advisor will develop a remediation plan with the Ph.D. candidate, this may include taking an additional class, a related TA assignment, or a series of self study and follow-up problems. The Ph.D. Advisor oversees the remediation plan.

COMPREHENSIVE EXAMINATION

The purpose of the Ph.D. comprehensive examination is to determine whether the student is ready for independent research in their chosen area of study. The comprehensive examination is administered by the student's graduate committee, and must be completed within two years after passing the qualifying examination. It is also recommended that the student has taken 2/3 of their graded coursework. In addition, students should have completed EGEN 694 prior to taking the exam; the course is designed to assist the student in preparing their proposal.

The Ph.D. comprehensive examination is comprised of:

- A written proposal for the student's Ph.D. dissertation, and
- An oral presentation of the proposal and oral examination.

The candidate will prepare a written proposal associated with the research topic for the Ph.D. dissertation, in a format designated by the Ph.D. Option. The successful proposal will include a

significant literature review, preliminary research to date, and the research proposed to complete the Ph.D. The written proposal will be presented to the student's graduate committee in advance of the oral presentation, by a date agreed to by the student and graduate committee.

The student will then present the dissertation proposal as a public research seminar that has been advertised to the College of Engineering. The public research seminar will include 40 minutes for the student's presentation and 10 minutes for questions from the audience. This will be followed immediately by a closed-session oral examination by the student's graduate committee on:

- the candidate's current and proposed research;
- the candidate's graduate level understanding of option specific engineering principles; and
- additional topics relevant to the proposed research, including fundamentals of other disciplines drawn upon in the research.

The candidate must (1) schedule a minimum **three-hour block** of time for his or her presentation and comprehensive oral exam, (2) reserve a room and equipment, (3) notify the committee.

The student's graduate committee will inform the student of the results of the comprehensive examination immediately following the oral examination and committee deliberation, and will document the results on the appropriate form filed with The Graduate School.

At the conclusion of the exam, each committee member will report a pass or fail evaluation of the candidate. Majority rule will determine the outcome. The committee chair is responsible to report the results of the examination using the Report on Comprehensive Exam/Thesis Defense form (<http://www.montana.edu/gradschool/forms.html>), signed by all committee members and the department head. A committee member may sign the examination form as a dissenter, in which case the Dean of the Graduate School may request further information before acknowledging majority rule.

A student not passing the comprehensive will have one opportunity to retake the comprehensive after a span of six months has passed. Failure to pass the examination on the second attempt is grounds for dismissal from the PhD program.

DISSERTATION DEFENSE

It is the responsibility of the student to ensure the format and delivery of the written thesis satisfies the requirements of the committee and the Graduate School (<http://www.montana.edu/gradschool/forms.html>). Thesis writing manuals are available at the MSU Bookstore and additional assistance for all graduate students for writing skills is available through the *MSU Writing Center*.

The last day to defend a thesis *if you plan to graduate during the same semester* is on or before the fourteenth (14th) business day prior to the end of the semester. At the dissertation defense, the candidate will make an oral presentation of the thesis in a seminar format open to the public. This will be followed by a closed-examination where only committee members ask questions of the candidate on topics pertaining to the dissertation. Questions may also cover coursework

related to the candidate's doctoral research. The candidate must (1) schedule a minimum **two-hour block** of time, (2) reserve a room and equipment, and (3) notify the committee. A draft of the dissertation must be submitted to the student's graduate committee at least 10 business days before the defense to allow time for reading by the graduate committee.

The student and the academic department are responsible for submitting an announcement to the MSU calendar system; <http://www.montana.edu/calendar> containing the following information:

- The name of the candidate.
- The title of the dissertation/professional project.
- The time and place of the defense.
- The location to obtain a copy of the dissertation/professional project for inspection.

At the conclusion of the defense, each committee member will report a pass or fail evaluation of the candidate. Majority rule will determine the outcome. A committee member may sign the examination form as a dissenter, in which case the Vice Provost of Graduate Education may request further information before acknowledging majority rule. The committee chair is responsible to report the results of the defense using the Report on Comprehensive Exam/Thesis Defense form (<http://www.montana.edu/gradschool/forms.html>) signed by all committee members and the department head. Written notification of the results within one week of the defense must be delivered to the Graduate School and the student.

If failure occurs at the first attempt, a second defense must be held. At least six months must elapse before the second examination takes place, with the time period not to exceed nine months. Failure of the second exam will result in suspension from the program.

ADDITIONAL MIE DEPARTMENT POLICIES

ACADEMIC HONESTY

Graduate students are expected to hold the highest standards of academic honesty. Adhering to a few simple guidelines should sufficiently meet this expectation:

- Do your own work. Any work submitted with your name on it should be of your sole, original authorship.
- Do not collaborate with others unless authorized to do so. When you do collaborate, note with whom and to what extent.
- Reference all external sources of information (books, journal articles, websites, etc.). Learn how to do this properly if you do not know how.
- Gain proper authorization before using any departmental equipment or facilities.

All graduate students will conform to the MSU Student Conduct Code, and if violated, will be subject to the sanctions outlined therein. All students should be familiar with the MSU Student Conduct Guidelines.

STUDENT OFFICES

The Department has a number of graduate student offices. Normally, only students appointed by the department on a Graduate Assistantship will be granted office space, but other students may acquire office space if any is left over. The staff in the MIE office assign office space on a semester-by-semester basis. If you have office space needs, please contact the MIE office staff. If a student has desk space available elsewhere but needs desk space for offering office hours or for a few hours in between classes, then there is desk space that can be booked on an hourly basis each week, please see the MIE office staff

GRADUATE TEACHING ASSISTANTSHIPS (GTA)

The Department has a number of Graduate Teaching Assistantships available each year.

Assignment:

A fulltime GTA will involve 19 hours of assigned work each week. The assigned work should allow adequate course study and preparation time so that GTAs have the ability to get up to speed on the course material before they have to grade assignments or tutor students. GTAs should expect to be assigned to no more than two separate courses. The GTA is offered with the understanding that the student will be working full-time towards the completion of a graduate degree. Continued appointment as a GTA depends on student performance, available funding, and evaluations from previous GTA instructors. GTAs for continuing students are normally requested by the student's advisor.

Stipends and tuition

PhD students: minimum \$1800/month for ten months, up to 9 credit tuition waiver per semester for courses on the program of study. Fees may be covered by the advisor.

MS students: minimum \$1500/month for ten months, up to 9 credit tuition waiver per semester for courses on the program of study. Fees may be covered by the advisor.

GRADUATE RESEARCH ASSISTANTSHIP (GRA)

The Department also offer Graduate Research Assistantships, which are funded and managed by individual faculty. The roles and responsibility for these positions – along with the amount of the stipend – will be determined by the individual faculty. Normally, the faculty member offering the GRA is also the chairperson of the student’s Graduate Committee. Continued appointment as a GRA depends on student performance and available funding.

TUITION WAIVERS

Tuition waivers can only be applied to credits that will be part of the graduate student’s Program of Study. All students **MUST** inform their advisor (GRAs) or the ME Graduate Coordinator (GTAs) if they are planning to enroll for credits outside of their program of study. Students are responsible for arranging to pay for those additional credits themselves unless permission is obtained from their advisor (GRAs) or the ME Graduate Program Coordinator (GTAs) for them to be covered another way.

MECHANICAL AND INDUSTRIAL ENGINEERING QUALIFYING EXAMINATION

1. Student makes a request for a qualifying exam to the Graduate Coordinator at the start of the Spring semester in which the student intends to take the examination. This exam should occur before the end of the third semester after matriculation in the PhD degree program.
2. The PhD Option Coordinator solicits a 30 - 40 minute written undergraduate level exam for each of the topics from faculty members currently teaching related courses.
Mechanical Engineering: Thermodynamics, Heat (energy) transfer, Fluid Mechanics, Structural Mechanics, Materials, Dynamics and Vibrations, and Mathematics
These exams may take any written format appropriate to the course such as essays, short answers, or problems (e.g., representative of final exams used in that course).
3. The exam will be open book (e.g., any texts, papers, course note) and exclude computers, cellphones, and internet access. Students pick the exam up from the MIE office ROB220 at 9am and will be told the location of the exam at that time.
4. The total time to complete the qualifying examination is five hours. Individual course exams will not be timed.
5. The exam is typically held on the second Tuesday in February. However, if necessary, the Graduate Coordinator can arrange another day in February.
6. After the exam, the PhD Option Coordinator distributes the student answers to the faculty members who wrote the questions for evaluation. Each faculty member grades their questions and submits a pass/fail evaluation to the PhD Option Coordinator within one week of the scheduled examination.
7. The PhD Option Coordinator then collates the evaluations to determine whether the student passed the exam. The student must pass at least four of the topics. Each student will receive a final grade of Pass (P), Fail (F) or Remediate (R), but the student does not see the results for each individual topic. (P) A student must pass each of four topics with a grade of B or higher. (R) A student earned a grade of C or less in one topic, and must remediate that topic. (F) A student earned a grade of C or less in more than one topic.
8. The PhD Option Coordinator informs the student and his/her advisor in writing of the results of the examination within two weeks of the time of examination. A copy of this letter is also placed in the student's file.
9. In cases where remediation in certain topic areas is required, the student's Ph.D. advisor will develop a problem-solving-based plan with the Ph.D. student to prepare for a retest on the identified topic areas. The retest must occur prior to the next fall semester and will be overseen by the Ph.D. Advisor.