



MECHANICAL ENGINEERING
COLORADO STATE UNIVERSITY

Graduate Student Handbook

For

Graduate Degrees
in Mechanical Engineering

2023-2024

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Introduction

Graduate study in mechanical engineering at Colorado State University (CSU) is intended to bring together faculty members and graduate students in a diverse community of scholars having a common interest in advanced professional study and creative work. The program seeks to extend the boundaries of the mechanical engineering profession by developing advanced technologies to provide creative solutions to global problems in energy, environment and human health. The major research areas in the Department of Mechanical Engineering at CSU include energy conversion, alternative energy, emissions and pollution control; biomechanics, biomaterials and nanobiotechnology; hybrid vehicles; building and transportation systems; laser diagnostics, atmospheric plasmas, and computational fluid dynamics.

Graduate Advisors

Successful completion of graduate studies requires close cooperation between student and advisor. A permanent advisor is usually assigned to every student upon admission based on the research area of the professor. The Associate Head for Graduate Studies serves as advisor to students who pursue the coursework-only Master of Engineering degree. The student and advisor work together to coordinate the plan of study, i.e. courses, research, committee members, etc. If a permanent advisor has not been determined by the start of the first semester, then the student may make an initial plan of study with the Associate Head for Graduate Studies.

Graduate academic advisors based on research areas are as follows:

<u>Advisor</u>	<u>Research Area</u>
Dr. Todd Bandhauer.....	Thermal Energy Systems; Phase Change Processing; Interdisciplinary Research
Dr. Tami Bond.....	Household Energy; Emission Mitigation; Physical, Optical and Chemical Properties of Particles; Emission Measurement and Characterization
Dr. Ciprian Dumitrache.....	Aerospace Propulsion and Diagnostics
Dr. Ben Gadomski.....	Translational Medicine; Medical Devices
Dr. Soham Ghosh.....	Biomedical Engineering – Mechanobiology, Biomechanics, Epigenetics, Cellular Engineering
Dr. Shantanu Jathar.....	Energy Systems, Air Pollution, Climate, Environmental Policy
Dr. Christian L'Orange.....	Air Quality Monitoring; Low-Cost Sensors; Engineering for Public Health; Household Energy Systems; Energy Access in The Developing World
Dr. Kaka Ma.....	Nanostructured Materials, Nanoscale Mechanics, and Sustainable Materials Engineering
Dr. Kirk McGilvray.....	Biomedical Engineering with emphasis on trauma and degeneration
Dr. Amit Munshi.....	Next Generation Photovoltaics
Dr. Reza Nazemi.....	Renewable Energy Utilization, Storage, and Transport
Dr. Daniel Olsen.....	Engines and Energy Conversion
Dr. David Prawel.....	Ceramic photopolymers for bone regeneration; Elastomeric biomaterials for cardiovascular healthcare
Dr. Jason Quinn.....	Microalgae Biofuels, Sustainability Assessment: LCA and TEA
Dr. Dr. Christian Puttlitz.....	Biomedical Engineering with emphasis on biomechanics
Dr. Donald Radford.....	Composite Materials
Dr. W.S. Sampath.....	Photovoltaic Solar Cell Manufacturing
Dr. Wade Troxell.....	Intelligent Control of Networked Distributed Resources
Dr. John Volckens.....	Sensors, Air Pollution, and Health
Dr. Christopher Weinberger.....	Computational Solid Mechanics and Material Science

Dr. John Williams	Plasmas and Ion Thrusters
Dr. Bryan Willson.....	Engines – Optical Combustion Diagnostics
Dr. Bret Windom.....	Combustion, flames, fuel characterization, diagnostics
Dr. Sing-Wan Wong.....	Advanced Therapeutics Development
Dr. Azer Yalin.....	Combustion, Plasma, Laser Sensors, Environmental Monitoring
Dr. Mostafa Yourdkhani.....	Composite materials; multifunctional polymers
Dr. Jianguo Zhao	Robotics and Controls

Colorado Residency

Domestic students are required to declare Colorado residency by the end of their first academic year, if legally able to do so. This is done by completing a variety of tasks, all of which are advised by the Office of Financial Aid. Students with questions about this procedure should work with the Office of Financial Aid to determine eligibility, current requirements, etc.

If you are a domestic, out of state student, be sure to review the Residency Office’s website for more information about obtaining residency (<https://financialaid.colostate.edu/residency/>). Also, plan on attending a Residency Orientation provided by the Office of Financial Aid as soon as possible after arrival on campus: <https://financialaid.colostate.edu/residency-orientations/>

**International students are not eligible to declare Colorado residency unless they are immigrating to the United States.*

Program of Study

Due to varying backgrounds and interests, specific courses for a program of study are selected by the student and advisor. Students without an undergraduate degree in mechanical engineering are required to follow prerequisite guidelines established by the student’s proposed advisor. Depending on academic background, these students may be admitted as second bachelor’s students or admitted directly into the graduate program.

The program of study is submitted to the Graduate School with the **GS6 form** during the third semester (not including summer if a fall or spring start). The student, Graduate Program Specialist, advisor, co-advisor (if applicable) and Department Head are required to sign the form. Students should confirm the all committee members’ willingness to participate prior to submitting the program of study. Programs of study need not be regarded as final in every respect. However, any changes made in the course selection will require advisor approval on the **GS25 form** (application for graduation) that is submitted the semester that the student plans to graduate. Committee member changes may be made on the **GS9A form** and also must be approved by the advisor and the committee members who are added or removed.

Thesis and dissertation work requires students to become involved in appropriate research activities. Graduate students will typically register for up to three formal courses each term, with four semesters typically required to complete the master’s degree and a subsequent six to eight semesters typically required to complete the Doctor of Philosophy Degree. Students are required to submit scholarly publications during their research (see “Publication Requirements” section). These articles may be appropriately incorporated as chapters in theses and dissertations.

Courses to be applied towards any mechanical engineering graduate degrees, including transfer credits from other institutions, must have been completed within the ten (10) years immediately preceding the date of completion of the final CSU degree. Transfer requests are submitted to the Graduate School with the GS6 Program of Study during the third semester and must include a course syllabus and a

transcript showing that the course(s) was not used for another degree. The Graduate School will notify the student by email when the **GS6 form** has been approved, meaning that the recommended committee is satisfactory, the transfer of credits is completed, and the program of study is acceptable. The maximum number of transfer credits for M.E. and M.S. degrees is 6 and for Ph.D. degrees is 10.

A full-time course load for graduate students is 9 credits per semester; however, there are many instances where a full-time course load is not required due to research activities and remaining number of credit hours required in a degree program. In cases where a graduate student is not registering for classes but is finalizing research and the thesis or dissertation, registration in the program must be kept current by registering for Continuous Registration (CR) through RAMweb. Students who are registered for CR may not be on contract for a research or teaching assistantship but may work as student hourly employees. **See Graduate School website for more information on CR:** <https://graduateschool.colostate.edu/policies-and-procedures/continuous-registration-graduate-enrollment-policies/>

Graduate Committee

To guide and supervise a student's progress for the M.S. and Ph.D. degrees, a graduate committee should be selected by the student and advisor before the end of the student's second semester of study. This committee is composed of the faculty advisor, an outside committee member from a department other than Mechanical Engineering, and additional co-advisors or committee members with appropriate faculty designations. The graduate committee makes regular evaluations of the student's progress and conducts/evaluates defenses for the preliminary and final exams. For more information about committee member requirements, see <https://graduateschool.colostate.edu/policies-and-procedures/advisor-committee/>.

Advisor and Graduate Committee Make-up

*Refer to Departmental Code for details of faculty assignments.

Master of Engineering (M.E. Plan C)

1. Advisor from the student's department (typically the Associate Department Head for Graduate Studies)
2. No graduate committee or outside member required

Master of Science (M.S. Plan A)

For M.S. candidates, the graduate committee must consist of at least three members:

1. Advisor from the student's department (can be tenured/tenure-track faculty or associate research professor—co-advisor must be tenure or tenured track if advisor is associate research professor)
2. A co-advisor or committee member from the student's department (can be tenured/tenure-track faculty, associate research professor, or teaching faculty)
3. An outside committee member from another department (tenured or tenure-track faculty)
4. A co-advisor or additional committee members from any department may be added to the student's committee, if appropriate, as long as items 1-3 above are met.

Doctor of Philosophy (Ph.D.)

For Ph.D. candidates, the graduate committee must consist of at least four members:

1. Advisor from the student's department (can be tenured/tenure-track faculty or associate research professor—co-advisor must be tenure or tenured track if advisor is associate research professor)
2. Two members from the student's department serving as co-advisor or committee member (faculty or staff member with tenured/tenure-track faculty or special faculty appointment)
3. An outside committee member from another department (tenured or tenure-track faculty)

4. A co-advisor or additional committee members from any department may be added to the student's committee, if appropriate, as long as items 1-3 above are met.

For detailed information on Advisor and Graduate Committee Makeup and committee member requirements, please refer to <https://graduateschool.colostate.edu/policies-and-procedures/advisor-committee/>

Core Course Requirements

Number of Required Courses

- M.S. students are required to complete **2** courses from the list of core courses with a grade of B or better.
- Ph.D. students are required to complete **3** courses from the list of core courses with a grade of B or better. One of these three courses must be one math courses selected from the following: ENGR 550, MATH 530, MECH 568, or CBE 521.

Core Course List

- *Mathematics for Scientists and Engineers, MATH 530
 - *Computational Methods for Mechanical Engineers MECH 568
 - *Mathematical Modeling for Chemical and Biological Engineering CBE 521
 - Advanced Mechanics of Materials, CIVE 560
 - Advanced Mechanical Systems, MECH 529
 - Materials Issues in Mechanical Design, MECH 532
 - Mechanical Engineering Thermodynamics, MECH 538
 - Advanced Fluid Mechanics, MECH 539
 - Advanced Heat Transfer, MECH 544
- *ENGR 550 or MATH 530 or MECH 568 or CBE 521 must be taken by all Ph.D. students*

Core Course Detail

- **Mathematics for Scientists and Engineers - MATH 530, 4 credits.** Proof-oriented linear algebra, ordinary and partial differential equations.
- **Computational Methods for Mechanical Eng. – MECH 568, 3 credits.** Fundamental principles which provide the foundation for the software and algorithms used in Mechanical Engineering.
- **Mathematical Modeling for Chemical Engineers – CBE 521, 3 credits.** Application of mathematical models to analysis and design of chemical reactors and separation processes.
- **Advanced Mechanics of Materials - CIVE 560, 3 credits.** Analysis of stress and strain failure theory; selected topics in solid mechanics, plate analysis; introduction to elastic stability.
- **Advanced Mechanical Systems - MECH 529, 3 credits.** Modeling, analysis, and synthesis of practical mechanical devices in which dynamic response is the dominant consideration.
- **Materials Issues in Mechanical Design - MECH 532, 3 credits.** Failure mechanisms from materials viewpoint with emphasis on use in design. Fracture, creep, fatigue, and corrosion
- **Mechanical Engineering Thermodynamics - MECH 538, 3 credits.** First and second laws of thermodynamics applied to engineering devices and systems. Introduction to availability, exergy, and lost work analysis.
- **Advanced Fluid Mechanics - MECH 539, 3 credits.** Kinematics, Navier-Stokes equations, vorticity, viscous flows, scaling analysis, boundary layers, secondary flows, entropy generation and transport, stability and transition, turbulence.
- **Advanced Heat Transfer - MECH 544, 3 credits.** Fundamentals and engineering applications of heat transfer including conduction, convection, and radiation.

Old version: Core courses may be substituted with equivalent graduate courses from other universities (as would often be the case for students who have completed their M.S. degrees elsewhere) or transferred from the MS degree to the PhD degree within CSU. Substitutions must be approved in writing by the Associate Department Head for Graduate Studies while transfer of requirements from the MS to PhD will be approved by the Graduate Program Specialist. To initiate course substitution process, students should email a syllabus for each course in question to the Graduate Program Specialist with a request for an exemption from the equivalent course on the core course list. Please note that such exemptions replace required courses but do not change the credit hour requirements for the degree. For core course transfer from the CSU MSME program, a simple email request to the Graduate Program Specialist is necessary indicating the core course requirements to transfer. The core course transfer does not alter the additional credit requirements of the degree.

Kirk's version:

Students may request substitutions of core courses with equivalent graduate courses from other universities, often applicable for those who have pursued their M.S. degrees elsewhere, or with core courses from the CSU MSME program. To ensure the quality of education, all substitutions need formal approval.

Course Substitution Approval: Students should email the syllabus of the prospective course to the Graduate Program Specialist, requesting an exemption from the equivalent core course. All exemptions are subject to written approval from the Associate Department Head for Graduate Studies. Please note, while substitutions replace requisite courses, they do not affect the degree's credit hour requirements.

Core Course Transfer: For transferring core course credits from the CSU MSME program to the PhD degree, students must send a formal email to the Graduate Program Specialist specifying the core courses to be transferred. This transfer does not impact the additional credit requirements of the degree.

Publication Requirements

Graduates from the M.S. and Ph.D. programs are required to publish in the archival literature of their research fields. The requirement is as follows:

- Graduation with the M.S. degree requires 1 publication in submission to a journal or conference by the time of the thesis defense.*
- Graduation with the Ph.D. degree requires 1 accepted journal publication and 1 submitted journal publication (or a 2nd paper) by the time of the dissertation defense.*

*Exceptions may be made by submitting a written petition to the Associate Head for Graduate Studies, e.g. in the case of restricting research contracts or intellectual property concerns, the requirement may be changed to a fully prepared paper for subsequent submission.

Notes:

1. The publication numbers given above are minimum requirements; having a larger number is encouraged. For students completing an M.S. followed by a Ph.D., the requirements must be separately met for each degree.
2. Journal publications should be in peer reviewed journals.
3. The publication requirement will be checked at the time of submitting the GS25 form (application for graduation) to the Graduate Program Specialist.

Students should be aware of potential copyright issues and should discuss them with their advisor. Additional information on copyright is available at: <http://lib.colostate.edu/etd>

Seminar Series

Graduate students in Mechanical Engineering are required to attend seminars and presentations. Seminars

include department seminars (invited speakers), preliminary or thesis and dissertation defenses, webinars, and conferences (conferences count as one seminar attendance). Master of Engineering students are strongly encouraged to attend. Accelerated Master of Science students must complete 4 seminars prior to scheduling their final thesis defense, Master of Science students must complete 8 seminars prior to scheduling their final thesis defense, and Doctor of Philosophy students must complete 16 seminars prior to scheduling their final dissertation defense. Seminar attendance must be verified by the faculty advisor in an email to the Graduate Program Specialist.

Quality of Work

Per Graduate School policy, students whose cumulative grade point average (GPA) is less than B (3.0), at the end of a semester will be automatically placed on academic probation. New students who are admitted with full graduate status will not be placed on probation until they have completed 12 credits or two semesters, whichever comes first. New students who are admitted with conditional graduate status will have one semester to achieve a 3.0 GPA.

Students are permitted one semester to bring the GPA back up to the required 3.0 to return to good standing. If this requirement is not met the student will be automatically dismissed from the Graduate School unless the student's faculty advisor and the Department Head agree to submit a petition to the Graduate School for a one-semester extension to return to good standing. If this requirement is not met, the dismissal will go through.

Credits earned for research (thesis and dissertation credits) and supervised teaching are graded as Satisfactory (S) or Unsatisfactory (U) by the faculty advisor. The student must maintain "S" grades to remain in good standing. Independent Study credits may be graded with a letter grade or with an S/U grade. The student must maintain a grade of "S" or "B" or better to remain in good standing. If the student does not maintain grades of "S" and "B" or better in these credits, the student will be placed on probation. These grades will also be considered in committee decisions about student progress, probation and/or dismissal.

Students will be reviewed annually by their advisor and/or committee to determine if they are making satisfactory progress towards the completion of their degree. A student's individual graduate committee or the department graduate committee may recommend dismissal upon finding that the student is making unsatisfactory progress toward the degree and that satisfactory progress cannot reasonably be anticipated. Such a recommendation must be documented in writing with substantive justification for this action in lieu of probation. It must be referred to the Department Head for approval and to the dean of the Graduate School for final action. The student may appeal such an immediate dismissal through the existing Graduate School grievance procedure. The full procedure is documented in the Graduate Bulletin: https://catalog.colostate.edu/general-catalog/graduate-bulletin/graduate-study/procedures-requirements-all-degrees/evaluation_of_graduate_students_and_graduate_school_appeals_procedure/.

To be eligible for graduation, a student must maintain at least a B average (3.0 GPA) in formal course work as well as satisfactory grades in research and other non-graded credits courses included in the program of study. Work graded C will be accepted toward degree requirements only if the GPA is still above 3.0. Repeated courses are added to the transcript but may not be removed. Grades of D, F, and U will not be accepted toward degree requirements. Grades of I (incomplete) must be replaced with appropriate letter grades within twelve months or the credits will be converted to an F grade. Students may not graduate with an "I" on their transcript.

Annual Ph.D. Student Evaluations

The annual student evaluation process assists students and advisors in planning for timely completion of

program requirements, provides consistent feedback to students as they proceed through the program, alerts students and advisors to problems, and provides students and advisors the opportunity to develop effective approaches for addressing those problems. Evaluation forms are available on the ME graduate website.

The first step of the process, the completion of Section A, requires students to provide a report of their academic and professional accomplishments over the past year. This allows students to assess their progress, keep their curriculum vitas/resumes up to date, and provide advisors with the information needed to evaluate student performance. The second step, the completion of Section B, requires advisors to review student progress to ensure that students are making satisfactory progress towards degree completion. After meeting to discuss the evaluation, both parties are required to sign and submit the evaluation to the Graduate Program Specialist for approval. If it is determined that the student has not made satisfactory progress towards degree requirements, the student's graduate committee will follow section E.1.3 of the Graduate and Professional Bulletin (https://catalog.colostate.edu/general-catalog/graduate-bulletin/graduate-study/procedures-requirements-all-degrees/evaluation_of_graduate_students_and_graduate_school_appeals_procedure/).

Financial Aid

Generally, Master of Engineering (coursework-only) students are not funded through Graduate Research or Teaching Assistantships. Master of Engineering students may be eligible for student hourly positions.

Graduate Research Assistantships (GRA) are negotiated between student and the supervising faculty member. GRA assignments involve significant assistance with research in the faculty laboratory, which may or may not be directly related to the student's thesis/dissertation topic. Graduate Teaching Assistantships support the undergraduate program, and as such, involve the Associate Head for Undergraduate Studies and the Associate Head for Graduate Studies in the selection process. Priority for Graduate Teaching Assistantships is given to students seeking the PhD, with consideration to the advising faculty member's previous use of graduate teaching assistantships as a funding mechanism. Assignments to undergraduate courses are made with regard to student background and preparedness to assist undergraduate students in a given subject.

Requirements for the Master of Engineering Degree (30 hours)

Plan C - Regular Coursework (no thesis)

- Minimum 30 credits of regular coursework (no thesis, independent study, or supervised teaching)
- Minimum 21 credits taken at CSU that are 500-level and above
- Minimum 21 credits taken after program admission
- Minimum 24 credits of mechanical engineering courses (must have prefix MECH)
- Advisor required but no Graduate Committee required

Please note: Mechanical Engineering, Aerospace Engineering and Advanced Manufacturing are specializations in the College of Engineering, Plan C, Master of Engineering degree; therefore, the Mechanical Engineering, Aerospace Engineering and Advanced Manufacturing titles only appear on the student's transcript and not on the final diploma.

Requirements for the Master of Science Degree (30 hours)

Plan A (thesis required)

- Minimum 30 semester credits of graduate work in approved course of study
- Minimum 24 semester credits earned at CSU in courses numbered 500 and above
- Minimum 21 credits taken after program admission

- Maximum 6 transfer credits (with original transcript) not counted towards any other degree
- Minimum 18 credits in regular courses numbered 500 and above (i.e. not including dissertation, independent study, or supervised teaching)
- Two core courses with a B or better
- Minimum one publication in submission
- Minimum 8 seminars attended
- Minimum of 6 and maximum of 12 thesis credits may be applied to the degree. Must be taken in MECH prefix.
- Final thesis defense
- Final thesis submission

Program

Students pursuing the Master of Science (M.S.) degree in mechanical engineering are expected to conduct research under the supervision of a faculty advisor who also is usually the Principal Investigator (P.I.) for a government or industry sponsored project. The student's research, in conjunction with thesis credits and coursework, will culminate in an article for submission to a peer-reviewed journal and a final thesis. The final thesis may incorporate findings from the article.

Thesis Defense

The thesis defense (also known as the final examination) is presented at the end of the master's degree program. It is most often an oral presentation describing the research and findings reported in the thesis. The defense is open to all mechanical engineering faculty, staff, and students and includes an open question period for all in attendance as well as a private question period for the committee.

Scheduling

The Department has set deadlines two weeks prior to Graduate School deadlines to avoid last minute emergencies that could prevent a student from graduating. It is the student's responsibility to schedule a room for the defense, obtain a template for the announcement from the Graduate Program Specialist, and to submit the announcement with abstract to the Graduate Program Specialist. Students should begin planning for the defense and thesis submission a minimum of three weeks prior to the defense and a minimum of four weeks prior to Graduate School deadlines.

Suggested Timeline

Three weeks prior to the defense:

- Confirm a date and time for your defense with your graduate committee

Two weeks prior to the defense:

- Contact the Graduate Program Specialist to provide you with a template for your announcement with abstract
- Submit announcement with abstract by email to Graduate Program Specialist for distribution and advertising
- Email a draft of the thesis (.pdf format) to your graduate committee and the Graduate Program Specialist

Two weeks prior to the Graduate School deadline for Thesis & Dissertation Submission:

- The final examination/defense should be conducted at least two weeks prior to the Graduate School deadline for Thesis & Dissertation Submission to allow for unexpected delays.

If circumstances prevent a student from meeting department deadlines, the Graduate Program Specialist should be informed by the student's advisor so that steps may be taken to ensure that the Graduate School

deadlines and requirements are met for the intended graduation term.

Graduate School Deadlines: <https://graduateschool.colostate.edu/deadline-dates/>

On the day of the defense

Students should submit the GS24 form prior to the start of the thesis defense through RAMweb. The Graduate Program Specialist will hold the GS24 until the start time of the defense, at which time the Graduate Program Specialist will release the form electronically to the committee. The student may choose to also submit the GS30 Thesis/Dissertation Submission Form for committee and department head signatures at the defense as a matter of convenience. However, the committee reserves the right to withhold signatures until they have seen the final thesis.

Results

At the conclusion of the examination, the committee members will sign the **GS24 form** under the “pass” or “fail” section. All committee members and the department head must submit their signatures via the electronic form within 2 days following the examination.

Thesis Submission

The student submits the Thesis/Dissertation Submission Form (GS30) to the Graduate School, after which the Graduate School provides directions for electronic submission.

Clearance to Graduate

In addition to submission to the Graduate School, the final dissertation also must be emailed (pdf preferred) to the Graduate Program Specialist for archiving before the student will be cleared for graduation (GS25B form) by the department. Graduating students also should check their “Graduate Degree Plan” in RAMweb for discrepancies or comments. Any issues found there must be resolved before the student will be cleared for graduation by the Graduate School.

Plan B (research project required)

- Minimum 30 semester credits of graduate work in approved course of study
- Minimum 24 semester credits earned at CSU in courses numbered 500 and above
- Minimum 21 credits taken after program admission
- Maximum 6 transfer credits (with original transcript) not counted towards any other degree
- Minimum 18 credits in regular courses numbered 500 and above (i.e. not including dissertation, independent study, or supervised teaching)
- Maximum of 6 credits in regular courses numbered 400 and above
- No 100-300 level courses may be used to satisfy graduate requirements
- Two core courses with a B or better
- Minimum 8 seminars attended
- Maximum of 6 credits MECH695 Independent Study
- Final examination
- Research project report submission

Program

The Master of Science in Mechanical Engineering Plan B is ideal for students who are interested in advancing their career in industry or research. The program combines valuable classroom instruction with research experiences. Students conduct research under the supervision of a faculty advisor, often the

Principal Investigator (P.I.), for a government or industry sponsored project. A few reasons for choosing Plan B instead of Plan A are, (1) the research scope is not large enough for a thesis, (2) the research is confidential and cannot be published in the open literature, and (3) the student prefers to spend more time on coursework.

Final Examination

The final examination is carried out at the end of the master's degree program. It is most often an oral presentation describing the research and findings. The final examination is open to all mechanical engineering faculty, staff, and students and includes an open question period for all in attendance as well as a private question period for the committee.

Scheduling

The Department has set deadlines two weeks prior to Graduate School deadlines to avoid last minute emergencies that could prevent a student from graduating. It is the student's responsibility to schedule a room for the defense, obtain a template for the announcement from the Graduate Program Specialist, to submit the announcement with abstract to the Graduate Program Specialist, and submit an electronic draft of the research project report to the graduate committee. Students should begin planning for the final examination a minimum of three weeks prior to the defense.

Suggested Timeline

Three weeks prior to the final examination:

- Confirm a date and time for your defense with your graduate committee

Two weeks prior to the defense:

- Contact the Graduate Program Specialist to provide you with a template for your announcement with abstract
- Submit announcement with abstract by email to Graduate Program Specialist for distribution and advertising
- Email a draft of the research project report (.pdf format) to your graduate committee and the Graduate Program Specialist

Two weeks prior to the Graduate School deadline for Thesis & Dissertation Submission:

- The final examination should be conducted at least two weeks prior to the Graduate School deadline for Report of Final Examination to allow for unexpected delays.

If circumstances prevent a student from meeting department deadlines, the Graduate Program Specialist should be informed by the student's advisor so that steps may be taken to ensure that the Graduate School deadlines and requirements are met for the intended graduation term.

Graduate School Deadlines: <https://graduateschool.colostate.edu/deadline-dates/>

On the day of the final examination

Students should submit the GS24 form prior to the start of the thesis defense through RAMweb. The Graduate Program Specialist will hold the GS24 until the start time of the final examination, at which time the Graduate Program Specialist will release the form electronically to the committee.

Results

At the conclusion of the examination, the committee members will sign the **GS24 form** under the "pass" or "fail" section. All committee members and the department head must submit their signatures via the electronic form within 2 days following the examination.

Clearance to Graduate

Graduating students also should check their “Graduate Degree Plan” in RAMweb for discrepancies or comments. Any issues found there must be resolved before the student will be cleared for graduation by the Graduate School.

Requirements for the Doctor of Philosophy Degree (72 credit hours)

With a Master of Science in Engineering

- Completion of 72 credit hours of approved graduate coursework required
 - 42 semester credits of Ph.D. graduate work in approved course of study
 - 30 semester credits automatically applied for M.S. in Engineering from an accredited university with original transcript
 - Maximum 10 transfer credits for courses numbered 500 and above, earned after the M.S. degree, and not counted towards any other degree (with original transcript)
- Minimum 32 credits earned at CSU
 - Minimum 21 credits in courses numbered 500 and above
 - Minimum 12 credits in regular courses numbered 500 and above (i.e. not including dissertation, independent study or supervised teaching)
 - Maximum 30 dissertation credits may be applied to the degree. Must be taken in MECH prefix.
 - Three courses from core course list (equivalents may be substituted)
- Minimum one journal publication accepted in a peer-reviewed journal
- Minimum one journal publication submitted or second manuscript completed
- Minimum 16 departmental seminars attended
- Oral Qualifying Examination (by the 4th semester)
- Ph.D. Preliminary Examination
- Ph.D. Dissertation Defense (final examination)
- Ph.D. Dissertation Submission

With a Bachelor of Science in Engineering

- Completion of 72 credit hours of graduate work in approved course of study
 - Maximum 10 transfer credits for credits earned after the bachelor’s degree not counted towards any other degree (with original transcript)
- Minimum 62 credits earned at CSU
 - Minimum 42 credits in courses numbered 500 and above
 - Minimum 30 credits in regular courses numbered 500 and above (not including dissertation, independent study or supervised teaching)
 - Maximum 42 thesis/dissertation credits may be applied to the degree. Must be taken in MECH prefix.
 - Three courses from core list
- Minimum two publications submitted to a peer-reviewed journal (or one publication submitted and second paper completed)
- Minimum one publication accepted in a peer-reviewed journal

- Minimum 16 departmental seminars attended
- Oral Qualifying Examination (by the 4th semester)
- Ph.D. Preliminary Examination
- Ph.D. Dissertation Defense (final examination)
- Ph.D. Dissertation Submission

These departmental requirements are minimums and may differ from general Graduate School requirements. In some cases, additional coursework may be required by a particular program and/or student's committee. For graduate school requirements, please refer to Section E.4.2 of the Graduate and Professional Bulletin at <https://catalog.colostate.edu/general-catalog/graduate-bulletin/>

Program

Students pursuing the Doctor of Philosophy degree in mechanical engineering will undertake advanced research under the mentorship of a faculty advisor (P.I.), most often on a government or industry funded project as a paid research assistant. The degree plan will involve consideration of a challenging problem utilizing analytical, experimental, and/or design techniques. The objective may be 1) to determine and explain the behavior of a simple system or 2) to bring into logical order the techniques of a field which has experienced random growth. This research - in addition to coursework, exams, journal articles, and dissertation credits - will culminate in a final dissertation. The dissertation will contain new analytical knowledge, experimental knowledge, design knowledge, or a combination thereof. Whatever its nature, the dissertation must make an original contribution to the field.

Ph.D. Oral Qualifying Exam

Purpose

The main objective of the exam is to ensure that all PhD graduates are able to demonstrate a mastery of the underlying theory specific to their dissertation research and a thorough understanding of theory in their engineering sub-discipline. The Oral Qualifying Exam is private and only open to the student's Examination Committee and his/her graduate advisor.

Examination Committee

The examination committee will consist of four (4) examiners, one of whom will act as a chair of the committee as soon as it is formed at the request of the student to be examined. The chair and one additional committee member must be tenure track or tenured faculty in the Department of Mechanical Engineering. The other two committee members can be filled by faculty inside or outside the department. However, if they are not faculty at Colorado State University, they are permitted on the Examination Committee only by approval of the graduate education committee (GEC).

The faculty advisor is not part of the examination committee but can be present during the examination as a courtesy. The faculty advisor has no voice on the committee.

Scheduling

1. The student must complete at least one year of graduate course work and all of the required Core Courses prior to taking the Qualifying Exam.
2. The student must take the exam by the beginning of their fourth semester in the PhD program. The exam can be taken earlier provided that criterion 1 is satisfied.
3. The student and examination committee must establish a day and time for the exam to be administered and the student must submit the intent to take the oral qualifying exam form at least 60 days prior to exam date.

4. The report of the oral qualifying exam must be submitted by the chair to the Graduate Program Specialist within 1 week of the examination.
5. With permission of the Associate Department Head for Graduate Studies, it is permissible to have one and only one committee member who is not the chair give their portion of the exam up to one week (7 calendar days) early due to scheduling conflicts. In this case, the committee member must provide, in writing, the examination results and comments from their portion of the exam to the committee chair. That examiner then gives up their voice on the outcome of the exam. The early examination of a single subject must occur prior to the rest of the exam. In the case of absence due to illness or other unforeseen circumstances, the exam must be rescheduled within 2 weeks. If this pushes the exam into the students 4th semester, this does not constitute a violation of point #2 above.

Format

1. The exam will be a 2-hour oral exam administered in four 30-minute segments by the Examination Committee.
2. The exam will consist of 4 topical areas, at least 2 of which will be from the following list of core subject areas. The associated Core Course is listed in parentheses as a general guideline for the topical area. However, the topical content of the oral exam is at the discretion of the examiner.
 - Thermodynamics (MECH 538)
 - Dynamics of Mechanical Systems (MECH 529)
 - Materials (MECH 532)
 - Solid Mechanics (CIVE 560)
 - Fluid Mechanics (MECH 539)
 - Heat Transfer (MECH 544)
 - Mathematics for Scientists and Engineers (MATH 530)
 - Computational Methods for Mechanical Engineers (MECH 568)

The remaining 2 subject areas may be based on the candidate's dissertation research topic subject at the approval by the Advisor and Examination Committee or otherwise should be based on coursework similar to the core subject areas listed above.

3. The Examination Committee can choose to conduct the oral examination on these topics in the context of the candidate's dissertation topic.
4. The Examination will be graded on an integer scale of 0 to 10.0 (scoring in increments of 0.1), with a maximum grade of 2.5 for each of the four topical areas. The final number grade will determine the outcome of the exam as follows:

Integer	Outcome
7.6 to 10.0	Pass
5.1 to 7.5	Pass with Conditions
2.6 to 5.0	Fail with Permission to Retake
0 to 2.5	Fail

Note that any committee member can require that a student complete additional work for any integer grade less than 7.6.

5. The Examination Committee will meet in private (without the presence of the thesis advisor) to

determine a final score on the 0 to 10 scale and assign the associated final grade of pass, pass with condition, fail with permission to retake, or fail. Those students who fail with permission to retake will only be allowed to retake the exam once.

6. The Examination Committee will report the results of the qualifying examination to the Associate Department Head of Graduate Studies within 1 week.
7. Students may elect to report official results via the GS14 Report of Department Examination form.

Research Advisor's Role:

1. The student's Research Advisor will work with the student to identify the 4 subject areas of the Qualifying Exam and the appropriate members of the Examination Committee for each subject area.
2. After agreeing on the recommended constitution of the Examination Committee, the student will contact the members of the Examination Committee to request their participation in the Qualifying Exam process and solicit a chair.
3. Having obtained consent from the Examination Committee members and Research Advisor, the student will obtain approval for the proposed topical areas and Examination Committee make-up by the Associate Department Head for Graduate Studies.
4. The Research Advisor may be present during the Qualifying Exam but will not participate in the examination process.
5. The Research Advisor may not be present for the private Examination Committee deliberation during which the final grade is assigned but will be a part of the post-examination debriefing (after the score has been determined).
6. The committee chair will communicate the results to the student and their advisor.

Ph.D. Preliminary Examination

Purpose

The purpose of the preliminary examination is to determine the candidate's background knowledge in the proposed dissertation area and to determine the adequacy of the current research plan to develop a satisfactory dissertation. The exam is based on the candidate's written research proposal that contains a detailed survey of the supporting literature, preliminary data, and a summarized research plan. Upon successful completion of the preliminary exam, the committee and student will agree to a final research plan that includes clear expectations for the content of the dissertation. The Preliminary Examination is generally closed to the student's graduate committee, but an advisor/student may elect to open up the presentation portion of the exam.

Scheduling

Prior to planning the preliminary exam, students should be actively conducting research with a faculty advisor, have the graduate committee confirmed, and have the **GS6 form** (Program of Study) on file with the Graduate School. The preliminary exam is conducted after an extensive literature review and collection of preliminary data which leads to a "working title" or definition of the research project and a written research proposal.

Students are advised to complete the preliminary exam within a year after passing the Ph.D. Oral Qualifying Exam. *The preliminary examination is required a minimum of two semesters prior to the final dissertation defense.*

Suggested Timeline

Three weeks prior to the preliminary exam:

- Confirm a date and time for your preliminary exam with your graduate committee. Schedule the room.

Two weeks prior to the preliminary exam:

- Contact the Graduate Program Specialist to provide you with a template for your announcement with abstract
- Submit announcement with abstract by email to the Graduate Program Specialist for distribution and advertising

Procedure

The exam will consist of the student’s presentation of the research proposal and questions by the committee to further assess the preparedness of the student to continue the degree, followed by analysis of the proposal by the student’s committee with recommendations for changes in the plan. The student and advisor will prepare a rough outline of the changes to the research plan suggested by the committee. The student has a maximum of two opportunities to pass the preliminary exam.

Results

By completing and signing the **GS16 form**, the committee shall:

1. **Pass:** recommend the student advance to Ph.D. candidacy and accept the research plan as agreed to by the committee during the exam
2. **Fail:** Recommend that the student take the preliminary examination again, if the student's research plan or background knowledge is unacceptable but the committee feels that the potential exists for satisfactory performance
3. **Terminate:** Recommend the student be terminated from the Ph.D. program

Students should submit the GS16 form prior to the start of the preliminary examination through RAMweb. The Graduate Program Specialist will hold the GS16 until the start time of the examination, at which time the Graduate Program Specialist will release the form electronically to the committee. Committee members must complete required signatures within 2 business days of completion of the examination.

Ph.D. Dissertation Defense

The Ph.D. dissertation is a major effort in which the doctoral candidate undertakes a program of work that will result in a significant contribution to the student’s major field of study.

Purpose

The purpose of the Ph.D. dissertation defense (also known as the final exam) is to allow faculty members and the public to critically examine and comment on the dissertation work and its significance and contribution to the research area and literature. Final examinations are open to the public and are conducted in a formal and professional manner.

Scheduling

The Department has set deadlines two weeks prior to Graduate School deadlines to avoid last minute emergencies that could prevent a student from graduating. It is the student's responsibility to schedule a room for the defense, obtain a template for the announcement from the Graduate Program Specialist, and to submit the announcement with abstract to the Graduate Program Specialist.

Suggested Timeline

Four to six weeks prior to the defense:

- Provide each committee member with a preliminary copy of the dissertation for review. Common courtesy to both the candidate and committee dictates that committee members be

given two weeks to reach a decision on the acceptability of a student's dissertation. During this time, they may request meetings with the candidate to discuss the dissertation and suggest revisions. After this review period, with majority approval by the committee, the candidate may schedule the dissertation defense. In the event that the candidate does not receive approval to schedule the public defense, the committee must make further suggestions to the candidate and set up a follow up meeting. Schedule the room.

Two weeks prior to the defense:

- Contact the Graduate Program Specialist to provide you with a template for your announcement with abstract
- Submit announcement with abstract by email to the Graduate Program Specialist for distribution and advertising

Two weeks prior to the Graduate School deadline for Thesis & Dissertation Submission

- The final examination/defense should be conducted at least two weeks prior to the Graduate School thesis/dissertation submission deadline to allow for unexpected delays.

If circumstances prevent a student from meeting department deadlines, the Graduate Program Specialist should be informed by the student's advisor so that steps may be taken to ensure that the Graduate School deadlines and requirements are met for the intended graduation term.

Procedure

To begin the presentation, the candidate is introduced by the advisor. The candidate then presents the findings of the doctoral research to the committee and to the public. The presentation is concluded with a public question and answer period, which is followed by a closed session where the committee members will decide whether to accept or reject the dissertation.

On the day of the defense

Students should submit the GS24 form prior to the start of the thesis defense through RAMweb. The Graduate Program Specialist will hold the GS24 until the start time of the defense, at which time the Graduate Program Specialist will release the form electronically to the committee. The student also may choose to submit the Thesis/Dissertation Submission Form at the defense as a matter of convenience, however, the committee reserves the right to withhold signatures until they have seen the final dissertation. This form must also be signed by the department head.

Results

If the dissertation is accepted the committee members will sign under the “pass” section on the **GS24 form**. If the dissertation is rejected, the committee will sign under the “fail” section, make recommendations that the student must complete in a given length of time, and may or may not schedule a second defense, noting the requirements on the form. Regardless of the results, committee members and the department head must submit their signatures on the GS24 within 2 business days of the defense.

Survey of Earned Doctorates

PhD graduates must complete the Survey of Earned Doctorates (<https://graduateschool.colostate.edu/current-students/steps-to-your-phd-degree/>)

Thesis Submission

The student submits the Thesis/Dissertation Submission Form (GS30) to the Graduate School, after which the Graduate School provides directions for electronic submission. Directions may also be found at:

<https://graduateschool.colostate.edu/current-students/steps-to-your-phd-degree/>.

Clearance to Graduate

In addition to submission to the Graduate School, the final dissertation also must be emailed (pdf preferred) to the Graduate Program Specialist for archiving before the student will be cleared for graduation (GS25B form) by the department. Graduating students also should check their “Graduate Degree Plan” in RAMweb for discrepancies or comments. Any issues found there must be resolved before the student will be cleared for graduation by the Graduate School.

Contact Information

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