

# Graduate Student Guide

George S. Ansell Department of Metallurgical  
and Materials Engineering

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## I. Introduction to George S. Ansell Metallurgical and Materials Engineering Department Graduate Programs

The aim of the Graduate Student Guide is to provide graduate students in Metallurgical and Materials Engineering a single reference to address the questions that arise with regard to policies and procedures at CSM and within the MME program. The Guide gives details about the requirements at CSM to earn an M.E., M.S., or Ph.D. degree in Metallurgical and Materials Engineering. It should provide the appropriate information to help students plan their degree program.

The MME graduate program has a strong tradition of ceramics, extractive metallurgy, and physical metallurgy programs as well as other materials and interdisciplinary programs. While most of the graduate students are associated with one of these research centers and groups, there is a common set of requirements for students to complete the MME degree programs.

The guide should be used by students to help navigate the requirements and expectations of the MME graduate programs in conjunction with other resources such as the graduate student bulletin, CSM Graduate School website, and individual faculty advisors. The MME graduate program is designed around the philosophy that graduate school is intended to be a period of concentrated individual study and research. In addition, it is one of the most intellectually stimulating and culturally broadening experiences in the life of a professional engineer or scientist.

## II. MME Degree Programs

### A. Master of Engineering Program

The Master of Engineering program is intended for students who would like to obtain a graduate degree without the thesis requirement. It is typically a 1 year program that is focused on coursework. The student must also complete and defend an Engineering Report, which presents the results of a case study or an engineering development. M.E. students should work on the Engineering Report during the whole course of their degree program. The report may include a small research study performed by the student, but a research study is not necessary for completion of the degree.

The requirements of the M.E. program are the following:

- i) A minimum of 24 credit hours of approved course work. M.E. students must also complete a minimum of 6 credit hours of research credits, listed under MTGN 700. The total credit hours for the degree must be 30 or greater. Only 3 credit hours of independent study, e.g. MTGN 599 can be applied toward the degree.
- ii) M.E. students must assemble a committee with 3 or more members. The committee includes the advisor, selected to help the student determine the topic and advise the student as they assemble information for the report, and at least 2 additional members from the MME Department. Prior to the end of the student's first semester, the committee and the DH need to approve the Admission to Candidacy, which includes the course list selected for the degree.
- iii) M.E. students must submit an Engineering Report, which presents the results of a case study or an engineering development, to their Engineering Report Committee. They must also defend the Engineering Report in an oral presentation to the committee.

A typical timetable for an M.E. degree is as follows:

1<sup>st</sup> Semester – Identify faculty advisor and committee; Develop course plan and obtain approval from committee; Take 12 credit hours of course work and 3-6 hours of research credits; Begin work on Engineering Report.

2<sup>nd</sup> Semester – Take 12 credit hours of course work and 3 hours of research credit; Finish Engineering Report; Graduate at end of semester.  
See Section III.A for form requirements.

### B. Master of Science Program

The Master of Science degree is intended for students who wish to pursue a degree beyond the Bachelor of Science with a large research component and advanced materials engineering courses. The research is performed under the guidance of a faculty advisor, and the thesis must present the results of an original materials engineering study.

The requirements of the M.S. program are the following:

- i) A minimum of 18 credit hours of approved course work. M.S. students must also complete a minimum of 6 credits hours of research, listed under MTGN 707. The total credit hours for the M.S. degree must be 30 or greater. Only 3 credit hours of independent study, e.g. MTGN 599, can be applied toward the degree.
- ii) M.S. students must assemble a committee with 3 or more members. The committee includes the advisor and at least 1 additional member from the MME Department. The committee and the Department Head need to approve all courses.
- iii) M.S. students must submit a thesis and successfully defend it in an oral presentation to the Thesis Committee in a public meeting. The thesis must present the results of original scientific research or development. The presentation is expected to be approximately 30-40 minutes and is followed by questions from the Thesis Committee and then questions from the audience. After all questions have been addressed, the Thesis Committee convenes privately to discuss the outcome of the thesis. The thesis defense typically lasts 2 hours.
- iv) M.S. students must have at least 1 manuscript submitted or ready for submission to a peer-reviewed journal or high quality conference proceedings before the thesis defense. If circumstances do not allow a student to meet the publication requirement, he/she may obtain a waiver from the requirement by submitting a request to be evaluated by the entire MME faculty.

A typical timetable for an M.S. degree is as follows:

1<sup>st</sup> Semester – Define research project and begin research; Develop course plan; Take 9 credit hours of course work and 3-6 hours of research credits.

2<sup>nd</sup> Semester – Continue research; Take 9 credit hours of course work and 3-6 hours of research credit.

Summer Term-Third Semester – Register as full-time graduate student with 9 research hours; Continue research.

Fourth Semester-Summer term – Obtain reduced registration status; Finish research and defend thesis.

### C. Doctor of Philosophy Program

The Doctor of Philosophy Program is intended for students who have a strong interest in pursuing higher level understanding of fundamental concepts through advanced course work and independent research. Ph.D. students are expected to evolve so that their research and learning is primarily self-guided with faculty advisor mentorship. Ph.D. students must present original ideas or concepts that are developed from their research and fundamental understanding of materials engineering concepts and literature. As such, the original ideas or concepts should reflect previously undiscovered materials behavior or be predictive of materials behavior.

The requirements of the Ph.D. program are the following:

- i) A minimum of 36 credit hours of approved course work. Ph.D. students must also take a minimum of 24 credit hours of graduate research, listed under MTGN 707. The total credit hours for a Ph.D. degree must be 72 or greater. Only 6 credit hours of independent study, e.g. MTGN 599, can be applied toward the degree. Credit hours earned for a Master's degree may

be applied toward the Doctoral degree if approved and provided that the Master's degree was in Metallurgical and Materials Engineering or a similar field. For students with graduate credit from another institution, at least 21 credit hours of approved course work must be taken at the Colorado School of Mines.

- ii) Ph.D. students must assemble a committee with 5 or more members. The thesis committee should consist of the advisor, at least 2 additional members from the Metallurgical and Materials Engineering Department, and at least 1 member from outside the Department. The committee and the DH need to approve all courses and any applicable Master's degree credit hours.
- iii) A passing grade on the written and oral Qualifying-Process Examinations must be obtained. Students can take qualifying exams in one of three areas: Physicochemical Processing of Materials, Physical and Mechanical Metallurgy, or Ceramic Engineering. There are both written and oral components to each qualifying exam. The written exam formats for each of the areas are as follows:

Area	Day 1	Day 2
Physicochemical Processing	Answer 4 questions on each of 2 3 hour exams	Answer all 4 questions in area of specialization
Physical and Mechanical Metallurgy	Answer 8 out of 10 questions on 6 hour exam	Answer all 4 questions in area of specialization
Ceramic Engineering	Answer all questions on 3 topics	Answer all questions on 2 topics, one mandatory and one declared

For the oral exam, students provide a list of fundamental concepts to the exam coordinator, which is provided to an oral exam committee in preparation for the oral exam. The student makes a 15 minute presentation to the oral exam committee about the fundamental concepts in relation to their research, which is followed by questions from each committee member on topics related to the concepts presented. The oral exam lasts for 2 hours.

Each portion of the exam is graded by the faculty responsible for the questions and oral exam. Students must average a 70% on the written and oral exams to pass.

- iv) A proposal on the Thesis-Research Project must be presented to the Thesis Committee within 6 months after completing the Qualifying-Process Examinations. The proposal document must be 15 pages or less and contain a summary of the critical background that justifies the research, a well-organized research plan, and expected results. The proposal will be presented orally to the Thesis Committee in a 20 minute presentation and will be followed by questions and input from the Thesis Committee. Proposal meetings typically last 2 hours. The proposal is meant to introduce the research project to the committee at an early stage in the process, so the committee has the opportunity to provide input. It is not a graded exam.
- v) It is strongly encouraged that students provide a Progress Report and Progress Review presentation to the Thesis Committee. The purpose of the Progress Review is to provide the Thesis Committee an opportunity to provide constructive input to the project at a point when the project direction is clear and when meaningful results have been obtained. The timing of the Progress Review should be such that there is time available to incorporate the Thesis Committee's recommendations. Thus, the Progress Review should be scheduled no later than 6 months before the anticipated thesis defense date. The Progress Report consists of a written document that is 15 pages or less. The document should contain a brief overview of the critical background and justification for the research, the project objectives, the experimental plan, critical results obtained since the proposal defense, and future research plans. The Progress Review will be presented orally to the Thesis Committee in a 20-25 minute presentation and will be followed by questions and input from the committee. Similar to the

- Proposal Meeting, the Progress Review is not a graded exam. However, the committee can request a follow-up meeting if there are substantial questions about the progress of the research.
- vi) Ph.D. students must submit a thesis and successfully defend it in an oral presentation to the Thesis Committee in a public meeting. The thesis must present the results of original scientific research or development. The presentation is expected to be approximately 40 minutes and is followed by questions from the Thesis Committee and then questions from the audience. After all questions have been addressed, the Thesis Committee convenes privately to discuss the outcome of the thesis. The thesis defense typically lasts 2 hours.
  - v) Ph.D. students must have at least 2 manuscripts submitted or ready for submission to a peer-reviewed journal before the thesis defense; alternatively, 1 manuscript can be submitted to a high quality conference proceedings. If circumstances do not allow a student to meet the publication requirement, he/she may obtain a waiver from the requirement by submitting a request to be evaluated by the entire MME faculty.

### III. Colorado School of Mines and MME Requirements

#### A. Form Checklist

Graduate students need to complete several forms during their degree program. The following table lists critical forms and a timeline for their completion. For more information, please refer to the MME Graduate Program administrator, the Graduate School website and the Graduate Bulletin.

<b>Form</b>	<b>Timeline for Completion</b>
Thesis Committee Form	First or second semester of appointment
PhD Qualifying Process Letter of Intent	Early in the semester you expect to take the qualifying exam. See department for specific dates.
Admission to Candidacy Form	M.E.: First semester M.S.: Second or third semester (can be submitted prior to completion of coursework) Ph.D.: After completion of coursework and qualifying exam process (including proposal and comprehensive exam)
Reduced Registration	M.S.: After completion of 36 hours of course and research credits Ph.D.: After completion of 72 hours of course and research credits Admission to candidacy form must be on file with Graduate Office within first week of first semester of reduced registration
Thesis Research Proposal Review (Ph.D. only)	After Proposal Review is completed
Thesis Research Progress Review (Ph.D. only)	After Progress Review is completed
Graduation Application	See Graduate School schedule; beginning of semester that student wishes to graduate
Thesis/Case Study Defense Request Form	Approximately 1-2 months before thesis/case study defense but a minimum of 1 week before defense date
Check Out Card/Work Completion Form	After thesis defense and corrections to thesis have been approved by advisor/thesis committee
Thesis/Dissertation Format Submittal page	Before submission of thesis to CSM Format Review
Hazardous Materials Checkout	Before graduation.
Graduate Publication Record	Due to the department the semester of graduation

#### B. Residency Requirement/Establishing Residency

It is in the interest of each graduate student who is a U.S. citizen and who is supported on an assistantship or fellowship to become a legal resident of Colorado at the earliest opportunity. Typically, tuition at the non-resident rate will be paid by Mines for these students during their first year of study only. After the first year of study, these students may be personally responsible for paying the difference between resident and non-resident tuition. In-state or resident status generally requires domicile in Colorado for the year immediately preceding the beginning of the semester in which in-state status is sought. See the Registrar website for more information: <http://inside.mines.edu/Petitioning-for-In-State-Tuition-Classification>.

### C. Full and Part Time Student Requirements

Graduate students are normally hired on full-time, 100%, appointments. However, assignments at fractions of the full-time equivalent status may be made in special circumstances.

### D. Basic Course Requirements and Course Deficiency Policy

Each MME graduate student is required to take at least one course in the areas of thermodynamics, kinetics, and properties of materials. Students who enter the program with an undergraduate degree from a different discipline may be required to undergraduate courses to make up for deficiencies in their background. A maximum of 9 credit hours of approved 400 level undergraduate coursework can be applied towards an MME graduate degree. All other 400 level courses and courses at lower undergraduate levels do not count towards the coursework requirements of the graduate degree programs. Students should coordinate with their advisor to determine course deficiencies and outline a plan for coursework.

### E. Course and Thesis Hour Registration and Reduced Registration

Each full-time graduate student must remain registered for at least 9 hours of course and research credits in the fall and spring semesters. Students may register for an overload of up to 6 credit hours (15 credit hours total) without additional tuition charges, which can be useful in circumstances where a student must drop a class but would like to maintain full-time graduate student status. After the coursework requirements are completed, students only register for research credit hours with their advisor. During the summer term, each graduate student on campus must register for at least summer research credits. Check the graduate school bulletin for the current requirements.

When M.S. students have attained 36 credit hours of course, research, and transfer credits, they can apply for reduced registration. Ph.D. students must attain 72 credits hours and have completed their admission to candidacy form. Only 12 hours per semester can be counted towards reduced registration. Reduced registration is encouraged because it saves funds from research contracts sponsoring students. Students on reduced registration only register for 4 research credit hours in the fall, spring, and summer, and they cannot register for course credit hours.

### F. Graduate Student GPA and Research Progress Requirements

Graduate students must maintain a minimum cumulative GPA of 3.0 in their course work. Students with GPAs that fall below 3.0 will be subject to the CSM Graduate School policies regarding academic probation and suspension of appointments. Additionally, graduate students are assigned research progress grades during each academic term from their advisor. Students with grades of “In-Progress-Unsatisfactory” or “Unsatisfactory” in any academic term will also be subject to the CSM Graduate School policies regarding academic probation and suspension of appointments.

### G. Research Ethics Requirements

All students who started their degree programs after the Spring 2010 semester and who are supported at any time in their graduate career through the National Science Foundation (NSF) as research assistants, hourly employees, or fellowship awardees must complete training in the responsible conduct of research (RCR). This requirement is in addition to all other institutional and program requirements. To satisfy the RCR requirement MME students must complete the one credit hour course, SYGN502. Students and advisors are required to certify successful completion of the NSF-RCR requirement as part of the Admission to Candidacy process.

### H. Vacation Policy

All vacation and leave from the Colorado School of Mines should be coordinated and scheduled with the faculty advisor. Spring break, Christmas break, summer break and any other holidays where the school is only closed for classes are not regarded as inclusive vacation periods for MME graduate students and staff. In fact, these times are often some of the most productive research periods.

### I. Safety Training/Lab Safety Requirements

All CSM graduate students, along with CSM faculty and staff, are required to attend a yearly safety seminar provided by the Environmental Health and Safety Department. Additionally, students must immediately learn the safety protocol, including safe practices and locations of emergency supplies, in their research laboratories and buildings. Safety issues should be brought to the attention of faculty advisors and the MME safety officers.

### J. Academic Integrity and Engineering Professional Ethics

The Colorado School of Mines expectations with regard to academic integrity and the student Honor Code appear in the Bulletin. Students should read this section at least once a year. The faculty members in MME strongly support the statements on academic integrity in the Bulletin. We expect that you will adhere to these policies and the honor code so that everyone can grow as true scholars.

Since most graduate students will become practicing Engineers, they should become familiar with Engineering Ethics. The Code below was adopted by the Accreditation Board for Engineering and Technology in 1977. The Code reads as:

Engineers uphold and advance the integrity, honor and dignity of the engineering profession by:

1. using their knowledge and skill for the enhancement of human welfare;
2. being honest and impartial, and servicing with fidelity the public, their employers and clients;
3. striving to increase the competence and prestige of the engineering profession; and
4. supporting the professional and technical societies of their disciplines.

#### The Fundamental Canons

1. Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
2. Engineers shall perform services only in the areas of their competence.
3. Engineers shall issue public statements only in an objective and truthful manner.
4. Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.
5. Engineers shall build their professional reputation on the merit of their service and shall not compete unfairly with others.
6. Engineers shall act in such a manner as to uphold and enhance the honor, integrity and dignity of the profession.
7. Engineers shall continue their professional development throughout their careers and shall provide opportunities for the professional development of those engineers under their supervision.

Other engineering societies have their own ethical codes. An excellent resource to learn more about engineering ethics is the website: [onlineethics.org](http://onlineethics.org).

## IV. Responsibilities of Graduate Students

### A. Research

Each full-time M.S. and Ph.D. student is funded to perform a thesis-based research project. Research and the associated independent learning is the most critical component of graduate level education. The research experience will hopefully cultivate students' excitement of discovery as well as develop their abilities in critical analysis, synthesis of information, and communication. During the initial portion of graduate students' degree programs, their time is split between research and coursework during the fall and spring semesters. Coursework is usually at a reduced load of 9 credit hours or less, and students are encouraged to balance their coursework requirements with their research requirements. It is

essential for the purposes of the MME program requirements and objectives that graduate students consistently produce research output in every term. During the summer, students generally only register for research credits and orient their activities entirely towards research. As full-time employees of CSM, graduate students are expected to provide full-time effort. It is in the best interest of each graduate student to complete their research activities to achieve their degree in a timely manner, while maintaining quality in their research.

#### B. Teaching Assistant Duties

Each full-time graduate student is usually accepted as a graduate research and teaching assistant. As such, each student is assigned a three hour teaching assistant (TA) assignment during each fall and spring semester. Often TA assignments allow graduate students to learn about laboratory equipment and gain additional exposure to materials fundamentals. They also provide TAs with opportunities to teach and interact in small groups with students, which may help graduate students identify whether they may consider teaching and leadership opportunities in their future careers. A three hour TA assignment essentially requires TAs to devote 3 hours per week during the semester. MME also receives Teaching Assistantship funds from the university that are distributed through each of the research centers. Individual students may be sponsored by these at times during their degree programs. Students with direct TA sponsorship may be required to fulfill TA duties up to 12 hours.

#### C. Coursework

MME graduate level coursework is generally designed to teach fundamental materials engineering concepts at a level beyond that which would be obtained from an undergraduate program. The course sequence can be designed for each student so they can obtain specialized knowledge in specific areas relevant to materials engineering. There is also flexibility in the program, so students may take engineering, science, or mathematics courses that are appropriate to their degree path and career objectives. Students are encouraged to work with their advisors and thesis committees to identify the course sequence that provides the background knowledge necessary for their research and satisfies their long-term goals.

#### D. Student Consulting and External Work

Occasionally, faculty will request that students work on consulting projects outside the thesis work. Consulting work typically provides income beyond the student's base stipend, and it is often an educational opportunity as it exposes students to specific materials engineering problems and the consulting process. Students should identify the expectations of the project requirements and time commitment with their faculty advisor. Typically, the time allocated for consulting projects is expected to be outside and beyond the time allocated for graduate coursework and research. In the case that a student is interested in an external opportunity not associated with the faculty advisor, the student must make their advisor and supervisor aware of the outside employment and receive permission from both to concurrently hold a Graduate Assistant or Graduate Hourly Appointment while working for an outside employer.

#### E. Employment

All paid graduate students are employees of the Colorado School of Mines and as such are subject to employee evaluations, policies, and training. Please see the Human Resources webpage (<https://inside.mines.edu/POGO-Human-Resources>) for more information regarding CSM employment.

## V. Department Information

### A. Obtaining an office, keys, email, and computer services

The Graduate Student Coordinator will assign offices to new graduate students upon their arrival to CSM. Offices are shared work spaces so please be considerate of your officemates in your work habits, office decorations, etc. Keys to offices can be obtained by completing a key request form and submitting it to the CSM Key Shop (<http://inside.mines.edu/Access>). Graduate students should also coordinate with their advisor to obtain keys to the necessary laboratories in Hill Hall and other campus buildings.

Graduate students will use several CSM computer services including Trailhead for course registration and employee information, email accounts, and network storage services. In order to activate CSM computer services, students should access [newuser.mines.edu](http://newuser.mines.edu). All students should set up a CSM email account. All CSM email communication will be sent to the students' CSM account, so graduate students should either use it as their primary account or set up a mechanism to forward CSM email to a separate account. For information about registering personal computers for on-campus network and internet access and other computing information, please see <http://inside.mines.edu/Getting-Started>. Refer to the official acceptance letter for more information about setting up computer services. For any other computing issues, submit a request to Campus Computing, Communications, and Information Technologies through [helpdesk.mines.edu](http://helpdesk.mines.edu). Our department has a representative that will monitor all requests and provide help if necessary.

### B. Financial Aid

Graduate research assistants in the Master of Science and Doctor of Philosophy programs are financially supported through research contracts. For full-time students, the support includes a stipend, tuition remission, health insurance, and payment of fees including Health Center, Associated Students, Athletics, Student Services and Assistance, Technology and Recreation Center. Students may elect to not use the CSM health insurance but must prove they have coverage through another plan.

Master of Engineering students must provide their own financial support but may seek outside resources in the form of scholarships, loans, grants, and hourly research contracts.

## VI. Facilities and Equipment Training

Each research group within MME obtains research equipment that is necessary for its research programs. The equipment may be accessed by students outside of the research group if permission and appropriate training is obtained. Several research facilities, including the physical metallurgy laboratory, mechanical testing laboratories, foundry, and electron microscopy laboratory are open to any student in the MME program with proper training.

A brief list of contacts is provided to obtain information about these facilities:

**Physical Metallurgy Laboratory** – Prof. Jerry Bourne ([bourne@mines.edu](mailto:bourne@mines.edu))

**Mechanical Testing Laboratories** – Prof. Kip Findley ([kfindley@mines.edu](mailto:kfindley@mines.edu)); Prof. Jerry Bourne ([bourne@mines.edu](mailto:bourne@mines.edu))

**Foundry** – Prof. Steve Midson ([smidson@mines.edu](mailto:smidson@mines.edu))

**Electron Microscopy** (<http://metallurgy.mines.edu/MME-Electron-Microscopy-Laboratory>) – Dr. Robert Field ([rfield@mines.edu](mailto:rfield@mines.edu)); Mr. Gary Zito ([gzito@mines.edu](mailto:gzito@mines.edu));

Other Department/CSM Activities

### A. Seminar

Weekly research seminars from invited experts are held during the fall and spring semesters. All graduate students are expected to attend and actively participate through questions and discussion. The

seminars provide additional learning opportunities faculty, staff, and students and exposure to materials engineering research being performed around the world.

#### B. Professional Societies

The student chapters of the materials professional societies have consolidated into one organization in MME called the Colorado School of Mines Materials Advantage Chapter (CSMMAC). CSMMAC includes the local Material Advantage Chapter, AWS, and NACE. Students are encouraged to participate in CSMMAC activities, which include outreach efforts, departmental social activities, speakers, and tours.

#### C. Graduate Student Government

The Graduate Student Government (GSG) is the governing body of and for graduate students at Colorado School of Mines. The GSG addresses issues of concern to graduate students at Mines and organizes various research, academic and social functions. All registered graduate students are automatically members of the GSG and are welcome to attend meetings and events. MME must elect one student to be the department representative to the GSG. More information can be found on the Graduate School webpage.

### VII. Housing and Local Information

#### A. Housing Information

Graduate students primarily live in Golden, but there is also housing available in the surrounding Denver suburbs such as Arvada, Wheat Ridge, and Lakewood. CSM owns and manages an apartment complex near campus called Mines Park (<http://inside.mines.edu/Apartments-at-Mines-Park>); there are apartments available for undergraduates, graduate students, and families. Housing information can also be found on campus bulletin boards and the International Office.

#### B. Parking and Transportation Information

Students can obtain parking permits to park in on-campus lots through CSM Parking Services (<http://inside.mines.edu/Parking>). RTD provides local transportation around the Denver and Golden area primarily with bus routes and an expanding light rail service.