# Materials Science Program Graduate Student Guidelines

Colorado School of Mines

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# Use of Guidelines

**This document describes guidelines and the stated requirements. The student's program can be modified with the consent of the Director and at the request of the advisor. The requirements described in this document do not replace the official school requirements stated in the CSM Bulletin for the year the student enters into the program. The student may request a more recent CSM Bulletin as his/hers official Bulletin.**

**It is recommended that the student carefully read the requirements in the CSM Graduate Bulletin as well as the Graduate Handbook. Please consult with your advisor and your Focus Area mentor if you have any questions.**

# TABLE OF CONTENTS

**OVERVIEW OF THE MATERIALS SCIENCE PROGRAM ..... 1**

**FIRST THINGS FIRST ..... 1**

Initial "To Do" Check List ..... 1
Other Important Information You Will Want to Know ..... 4
*Home Department* ..... *5*
*Housing* ..... *5*
*Prerequisites/Deficiency Courses/Placement* ..... *6*
*Initial Selection of Courses* ..... *6*

**THE FIRST SEMESTER ..... 7**

Deadlines and Forms ..... 7
MET Student's Monday Morning Minders ..... 7
Financial Aid ..... 7
Activities and Collateral Duties ..... 7
Residency Requirements ..... 7
Graduation Checkout Deadlines (How to Avoid Paying for another Semester) ..... 8
Reciprocal Registration ..... 8
Leave of Absence ..... 8
Student Fees and Health Insurance ..... 8
Paying Tuition and Fees ..... 8
Professionalism ..... 9
Remaining in Good Standing ..... 9
Materials Science Student/Faculty Seminar Requirements ..... 9
Safety ..... 10

**GENERAL REGISTRATION REQUIREMENTS ..... 12**

How to Register ..... 12
Eligibility for Thesis (Reduced) Registration ..... 13
Registration Requirements for Summer and Field Appointments ..... 13

**ADVISOR/THESIS COMMITTEE/THESIS DEFENSE PROCESS ..... 15**

Selection of an Advisor ..... 15
Selection of a Research Project ..... 15
The Thesis Committee/Proposal Process ..... 15
Steps for Defending Your Thesis ..... 16

**EDUCATIONAL PROGRAM ..... 18**

Degrees Offered ..... 18
Program Description ..... 18
*Master of Science Degree Program with Thesis* ..... *18*
*Master of Science Degree Program - Non-Thesis* ..... *19*
*Conversion of Master Program to Doctor of Philosophy Degree Program* ..... *20*
*How to Change Your Degree Program* ..... *20*
*The Doctor of Philosophy Degree Program* ..... *21*
Fields of Research ..... 22

**FOCUS AREA FLOWCHARTS ..... 25**

Focus Area Chart Organization ..... 25
Required Courses for all Focus Areas ..... 25
Acceptance Procedure for Material Science PhD Program ..... 26
The Dashed Line ..... 27
The Mathematic Requirement ..... 27
The PhD Qualifier ..... 27
Advanced Polymeric Materials Focus Area ..... 28
Ceramics Focus Area ..... 29
Composite Focus Area ..... 30
Electronic Materials Focus Area ..... 31
Joining Sciences Focus Area ..... 32
Mechanics of Materials Focus Area ..... 33
Computational Materials Science Focus Area ..... 34
Surface & Interfaces/Films & Coatings/Corrosion Focus Area ..... 35
Biomaterials Focus Area ..... 36
Nuclear Materials Focus Area ..... 37
Enviro-Material Focus Area ..... 38
Mining Materials and Petroleum Materials Science Focus Area ..... 39
Non-Destructive Materials Assessment Focus Area ..... 40
Materials Chemical Processing Focus Area (In preparation) ..... 41

**APPENDIX A ..... 42**

Forms Online ..... 42

**APPENDIX B ..... 44**

Master of Science Program Check List ..... 44

**APPENDIX C ..... 45**

Doctoral Program Check List ..... 45

**APPENDIX D ..... 47**

Required Courses For The PhD Qualifying Process Exam ..... 47

**APPENDIX E ..... 48**

Thesis Writer's Guide ..... 48
Signature Page - Thesis ..... 48
Thesis Flowchart/Checklist ..... 49

**APPENDIX F ..... 50**

Information on the Establishment of Domicile for Tuition Purposes ..... 50
*Colorado Residency for Tuition Purposes ..... 50*
*Petitioning for In-State Tuition Classification ..... 50*
*Summary of Statutory Requirements ..... 51*
*Domicile ..... 51*
*Emancipation ..... 52*
*Military Personnel ..... 52*
*Foreign Nationals ..... 53*

## Overview of the Materials Science Program

Welcome to the Materials Science Program at the Colorado School of Mines. You have joined a select group of highly qualified graduate students. This interdisciplinary graduate program provides a wide range of options that contribute to your individual program.

The interdisciplinary materials science program is a collaboration of the Departments of Chemical Engineering, Chemistry and Geochemistry, Metallurgical and Materials Engineering, Physics, Engineering, Environmental Science and Engineering, and Mining Engineering. The range of disciplines provides a Materials Science degree within one of the fourteen focus areas (see Focus Area Flowcharts).

John J. Moore is Director of the Materials Science Program. Professor Moore is responsible is responsible for the overall direction of the Program. The Lead Scientist, Professor David Olson (303-273-3955, dolson@mines.edu) is responsible for the day-to-day operation of the Materials Science Program.

## First Things First

### *Initial "To Do" Check List*

The following list of items should be completed soon after arriving at CSM. You will be given more information about the campus and surrounding area at the New Student Orientation given in the student center prior to the beginning of each semester. You are encouraged to attend this informative session.

➔**Blaster Card –** A BlasterCard is your official identification as a Mines student. You will need it for most activities on campus including getting keys, copying, library, etc. The BlasterCard is also an electronic key that allows you access to Hill Hall entrances and the undergrad computer lab after hours (The graduate computer lab is in the undergrad computer lab). In order to get a BlasterCard, you will need your student ID# which can found on your acceptance letter from the graduate school. Go to the BlasterCard Office in Ben Parker Student Center, Room 238. The office is open Monday thru Friday from 8:00 am to 5:00 pm, excluding campus holidays. You must be continuously registered (fall, spring, field and summer) for your Blaster Card to remain active. Be aware that for any period in which you are not registered (Field Session for example) your BlasterCard will not work. For more information about the BlasterCard, see http://www.is.mines.edu/BlasterCard.

➔**Parking** –All vehicles parking within the boundaries of the CSM campus are required to display a CSM vehicle registration permit or a temporary parking permit. A Student Parking Fee of $50.00 per semester (currently) is payable at registration. This fee includes vehicle registration and a variety of other services. This fee may be waived each semester if a student does not bring a vehicle to campus. The waiver form must be submitted to Nan Braddock in Plant Facilities within the first 30 days of classes each semester.

Parking Services has moved to Plant Facilities. See Nan Braddock, Parking Services, Manager, (303) 273-3023 Office, (303) 384-2036 Fax, Nan.braddock@is.mines.edu or the web for parking issues.

➔ **Graduate Offices -** Graduate offices are assigned by Professor Brajendra Mishra and Connie Sanford. Please be aware that we are running out of space and will do our best to place you in an office. You may be placed on a wait list until an office becomes available. **Note: When you leave CSM, clean out your office and laboratory areas. The Department is not responsible for your personal goods left in your office or laboratory after you have checked out from CSM. After a short time, they will be tossed. Do not lose your notebooks, textbooks and personal goods because you did not remove them.**

➔ **Keys** – Your research center secretary or advisor will tell you what laboratories you need to access. You need the laboratory name and/or the room number to fill out the form. Dr. Mishra (or Connie Sanford in HH206) will assign your office. The key form can be found at http://metallurgy.mines.edu/emlab/keyrequest1-1_mme.pdf or is on the desktop of the student computer in the office.

1) After consulting with your advisor, Connie Sanford/or Dr. Mishra, fill out the key form. Put all the keys requested on the same form.

2) Laboratory keys must be initialed by the faculty or staff in charge of the laboratory. After you get the laboratory signatures, give the form to Scott Pawelka, Building Proctor (HH219). If Scott is not available, put the form (face down) in Scott's mail box in the MME office.

4) Scott Pawelka will process the form as soon as possible and return it to the student (or student's mail box). Take the form to the lock shop located in the Facilities Management building (across the street west and north of Guggenheim) to pick up your keys.

6) Lock Shop hours of operation will be 7am-5pm; Monday and Tuesday 7am-9am; Wednesday and Thursday 12pm-2pm' Friday 1pm-3pm (beginning of each semester hours).

7) Blaster card access is almost instantaneous, but please allow one hour from the time Scott Pawelka processes the key form.

➔**CSM Computer Account and Email Address** – You need to create three accounts: 1) Your Trailhead campus portal account provides access to academic, student life, and administrative business services. It provides you with a personal calendar, access to Blackboard, webmail and other services. You must use this account to use the "Self Service" features so you can confirm your attendance, register for classes, select or waive a health insurance plan, update your address, see your campus account, financial aid, and grades, drop and add classes, and authorize use of Colorado Opportunity Fund money. 2) An e-mail account is required to use campus e-mail and some other academic services. 3) an ADIT account is needed to use general PC Laboratories. The e-mail account provides you with e-mail and Blackboard services, general Unix access, some protected web services (such as campus housing network activations, antivirus software downloads, e-mail list management, and others) and authorizes you to use campus modem pools. The ADIT account gives you access to PCs in the Computing Center, CTLM, Library, and Writing Center Laboratories. It also creates home directory space which

you can access from your personal PC. Go to http://ccit.mines.edu/gettingstarted/ for more information about computer start up.

– **Metallurgy and Materials Engineering Computer Laboratory Account** – Using any computer, go to http://helpdesk.mines.edu. Ask for CSMMME server access.

➔**Trailhead -** Trailhead is the school's single entry point for fast and easy access to web-based services and applications pertinent to currently enrolled students, faculty, staff, and employees. First Time Login to Trailhead:

1. **How to activate your Trailhead account:**
   Open a web browser to http://newuser.mines.edu/trailhead/. You will need your campus user name and EKey from your accept letter.
2. Check our System Requirements to make sure you have a supported web browser.
3. Open a web browser to http://trailhead.mines.edu/
4. Enter your username and the password you set in step 1
5. First-time only: you will be required to set 5 security questions/answers (to be used with the Trailhead "Forgot your password?" tool).

** New Graduate Students **: If you have not yet received an EKey, please follow the instructions sent with your acceptance letter for accessing your Trailhead account for the first time, or if you are on campus, bring a photo ID and your CWID to the Computer Commons Front Desk (CTLM 156A) during regular business hours.

**Basic Trailhead Account Info:**

Trailhead accounts are automatically created after a student or employee is entered into the Banner system. This creation happens after a student has officially indicated that they "intend to enroll" for the coming term or after an employee is entered into the HR/payroll system. The important component of your data being entered into Banner is that you are assigned a Campus Wide ID (CWID) and username, and are set as an active or current student, employee or faculty. A Trailhead account cannot be created without a CWID, username, or active status for the user.

1. Your username is printed on the left side of the mailing containing your EKey.
2. If you no longer know or have your EKey, or if you are a new student and have not yet received your EKey mailing, see Lost EKey information.
3. Lost EKeys cannot be retrieved. A new EKey can be issued.
4. Your Trailhead username is typically the same username used for other systems on campus, such as central campus email, slate, blackboard, and laboratory accounts.

Go to http://inside.mines.edu/trailhead/loginfaq.shtml for more information.

➔**Copy Cards** – all campus copy machines require a copy card (some use the BlasterCard). Hill Hall copy machines use the copy card, not a BlasterCard. You may purchase them at the Copy Center, Guggenheim (bottom floor).

➔**Register for Classes** – the online Course Schedule is the most up-to-date list of classes. After discussion with your advisor, you can register online.

➔**Email Distribution Lists** – Subscribe to the following lists by sending an email with these addresses in the text to postmaster@mines:

- mt-grad-students-announce@mines.edu
- mt-grad-students@mines.edu

➔**Mailbox** – You will have a mailbox in Graduate Coordinator's office, HH206. If you do not see your mailbox, let Connie Sanford know and she will create one for you. Please do not let mail build up in your box. The boxes are not secure and personal and financial information should not be left in your mailbox. Remember that when you leave CSM, mail left in your mailbox will be thrown away.

➔**Make an appointment with Professor David Olson** (x3955 & email dolson@mines.edu) to meet with him for 30 minutes to discuss your program.

### *Other Important Information You Will Want to Know*

- **FAX Machines** - Use of a departmental facsimile may vary between departments/divisions. Check with your home department/division's ***Main Office*** for policy. In Hill Hall, you are expected to use your research center's fax machine if at all possible. If you receive a fax on the machine in HH206, the fax will be placed in your mailbox. Remind vendors when you order items to include your name as a contact. Both packages and emails arrive addressed to "Hill Hall" which is not much help in getting the stuff to you.
- **Gas Cylinders/Chemicals/Laboratory Equipment** - Contact your research center or advisor for information regarding placement of gas orders, need for chemicals or equipment.
- **Hazardous Waste and Chemicals** - Contact your home department/division ***Main Office*** for Chemical Recycling Waste Disposal forms, Container ID Tags, and Hazardous Waste Labels.
- **Office Name Signs** - If you have an office in Hill Hall and would like a name sign for your office, contact your research center and request an office name sign.

**Purchasing Forms for Supplies** - The forms required for purchasing supplies are listed below. Contact the research office secretary for forms and procedures.

(1) Central Stores Requisition - This form is used to purchase paper supplies stocked in the CSM Warehouse-copy paper, envelopes, forms, etc.

(2) ISSV (Interdepartmental Sales/Service Voucher) - This form is used to purchase something from another depart department on campus.

(3) Field Purchase Order (FPO) - To buy an item that costs less than *$1000.00*.

(4) Purchase Requisition (PR) – To buy an item that costs more than $1000.00. Send the form with estimate attached to the purchasing department.

**Please be aware that the above forms must be ordered by your research group. There is a charge for the forms from CSM. The main office and/or graduate office cannot supply your research group.**

- **Telephone** – The graduate offices are not set up for long distance nor will most of the phones take messages.
- **How to contact others on campus** – The easiest way to contact someone or a department on campus by phone is to dial x3000, say the name of the person or department you wish and you will be connected. To contact a person on campus via email, use the person search on the main page of CSM's web site or go to the department's web site.
- **Travel** - When you take a trip funded by a university account, you must complete a Travel Authorization (TA) form before you leave and a Travel Expense (TE) form within three days after returning. Electronic travel forms and help on filling them out can be obtained from Connie Sanford, HH 206.
- **Web pages** – Check out the Department's web pages!

Your Research Center may have a secretary who can help with many of your needs. For program questions, please check with your advisor. Also, drop by to see Connie Sanford, Graduate Education Specialist, HH206. You may email her at csanford@mines.edu or call her at x3660.

### Home Department

The department/division listed on your acceptance letter is your home department. Your advisor will be a member of that department. In addition, your office will be located in that department.

### Housing

If you are arriving from outside of the Denver metro area, make early arrangements for housing. There are some dormitory rooms and student apartments available through the CSM Housing Office (located in the Ben Parker Student Center). Their telephone number is: 303-273-3351. Normally there is a wait list for these units.

Most graduate students live in apartments in the Golden area. However, demands for these units are high and prices are generally higher than for comparable units in the west Denver suburbs. The latter normally requires provision for private transportation.

While the CSM Housing Office does not make off-campus arrangements for students, they do maintain several bulletin boards on which housing vacancy notices are posted. In addition, present graduate students often have the best information on what units may become available.

**Prerequisites/Deficiency Courses/Placement**

New graduate students possess varied educational backgrounds. Experience has proven that you need to possess certain fundamental knowledge to successfully pursue our graduate program. The faculty mentors for the Focus Areas have identified the minimum background requirements: See the Focus Area Flow Charts for prerequisites for each program. Your advisor or program mentor in the focus can answer questions about courses or required prerequisite courses. If you have not completed the prerequisite course requirements, be prepared to take the relevant deficiency course(s). Graduate credit is not granted for deficiency courses. In a case where you request exemption from any of the courses, you will be asked to provide evidence of completion of the course(s). Evidence may be in the form of transcripts, texts, and course outlines. Alternatively, you may ask to take a placement exam in the subject in question.

Make an appointment with Professor David Olson, Lead Scientist (303-273-3955) to become familiar with the Materials Science Program and to discuss any of your concerns.

**Initial Selection of Courses**

Your initial course schedule should be decided with help from your advisor and from your Focus Area mentor. Use the Focus Area flow charts found in this Guideline as a guide. Meet with your advisor and/or Focus Area mentor.

## The First Semester

You will be busy during the first year with course work and research assignments. Several decisions must be made during this period if you are to complete the program in a timely manner.

### *Deadlines and Forms*

During the course of your studies, you will be required to fill out and submit a number of forms. Most of the forms have "drop dead" deadlines set by the Graduate School. Go to the Graduate School web page at http://gradschool.mines.edu/index.html to familiarize yourself with the forms and the deadlines. The deadlines are also listed on the monthly calendar in the Graduate Student Handbook. In addition to the Graduate Student Handbook, you should thoroughly read the Bulletin including the front section where general graduate information is given. Most of the deadlines will also be given in the weekly email "Met Student's Monday Morning Minders." However, each grad student is responsible for knowing the requirements and the deadlines.

### *MET Student's Monday Morning Minders*

You will receive an email every Monday morning giving you events for the week including the Student and Research Seminar speakers with the seminar title and abstracts. The email also includes a list of dates for documentation submittal.

### *Financial Aid*

The Materials Science Program makes every attempt to provide financial aid for its full-time graduate students. The home department awards financial aid. The amount and financial aid conditions and department sponsor are clearly specified in your acceptance letter. The traditional forms of financial aid are fellowship support or appointments such as teaching or research assistantships. Normally, financial aid is not offered to provisionally accepted students, non-thesis (ML ME) students, or combined undergrad-graduate (BS/ME) students.

### *Activities and Collateral Duties*

When possible, you will be given the chance to experience both teaching and research activities. All graduate students housed in Hill Hall will be required to donate a minimum of three hours per week to help in the educational program in the home department/division. TA assignments will be posted on the HH206 door. Please be professional in honoring your assignment.

### *Residency Requirements*

U.S. citizens are expected to take immediate steps to obtain Colorado residency by the beginning of their second year. See Appendix F for detailed requirements and procedures for obtaining residency.

### *Graduation Checkout Deadlines (How to Avoid Paying for another Semester)*

Graduate students must complete all graduate degree requirements **before the last day of registration** for the next semester to avoid having to register and pay fees for that semester. That means that all the paperwork including Work Completion Form and Check Out card must be submitted to the Graduate Office before the end of registration of the next class period. If you fail to meet this deadline, you are considered to be a student and must register and pay fees. In the summer, the deadline is close of registration for the first field session.

### *Reciprocal Registration*

Graduate students registered full time at CSM may take courses at Colorado State University, University of Northern Colorado, and the University of Colorado if they meet all of the required conditions for enrolling. Complete the Request Form EX102 available from the CSM Registrar's Office.

### *Leave of Absence*

Students who choose not to register for the fall or spring semesters must submit a formal Request for Leave of Absence (form) which requires approval from the faculty adviser, Department Head and the Office of Graduate Studies. The request must include 1) the reasons why you must interrupt your graduate studies and 2) a brief explanation and a plan for completing the work toward your degree in a timely fashion. Only the Dean of Graduate Studies, the advisor, and the Department Head can grant leaves of absence. **If you must leave CSM, it is in your best interest to submit a formal Leave of Absence.** Students who do not submit the form or fail to return at the end of one year while under the formal leave of absence policy must apply for readmission and pay a $200 readmission fee. Also, they must be accepted and funded by an advisor before they can be readmitted.

### *Student Fees and Health Insurance*

All students (undergraduate and graduate) registering for 3 or more hours will be assessed mandatory student fees. All students (undergraduate and graduate) will be assessed a health insurance fee at the time of registration. The health insurance fee can be waived by providing the Registrar's Office with proof of other insurance. **If you waive your health insurance one semester, it is not automatically reactivated the next semester. You need to check with Student Health prior to the beginning of the semester.**

### *Paying Tuition and Fees*

Tuition and fees are payable on the day of registration. Late payment penalties are assessed on the unpaid balance. Pay at the Cashier's Office by personal check or cash. CSM-funded students (TA or RA contracts or fellowships) will have all or part of their tuition paid automatically. The student is responsible for paying on time any part of the tuition and fees not covered by financial aid or his/her contract.

Sponsors (parents, companies, governments) must fill out a **Sponsor Billing Form** available in the Student Receivables Office. CSM will bill the sponsor. The student is responsible for any tuition and fees not paid by the sponsor.

### *Professionalism*

Graduate students are expected to meet the School's high ethical standards. Any student found guilty of academic dishonesty (cheating or plagiarism) may be expelled. Read the policies and requirements in the CSM Graduate Bulletin. One of the most important lessons to be learned in a graduate program is ethical and professional behavior. Professional behavior can take many forms but in essence, it is treating others as you want to be treated.

- Replace tools for the use of others in a timely fashion
- Leave a clean working environment and functional equipment for the next student
- Report damaged equipment immediately
- Be willing to be properly trained in the use of the needed processing and analytical systems
- Create a pleasant and respectful working environment for you and your colleagues
- As a professional, you are expected to attend the Materials Research and the ML graduate student seminars. You will be asked to be a participant in the ML graduate student seminar starting with your second semester.
- You are also encouraged to join a professional society and participate in their activities

### *Remaining in Good Standing*

Graduate students must maintain a cumulative grade point average of 3.0 in both graduate and undergraduate courses. Falling below the grade standards places the student on academic probation. If the cumulative average is not raised by the end of the semester, the student will be dismissed. The CSM Graduate Bulletin defines unsatisfactory academic performance and how it is determined, describes discretionary and mandatory dismissal, and gives the appeal and review procedure.

### *Materials Science Student/Faculty Seminar Requirements*

The Materials Science graduate student seminar policy is based on the following beliefs:

- Good oral communication skills are essential for a successful professional career.
- A professional should make a habit of life-long learning.

To provide this component of your educational experience, the following seminar requirements have been established:

**You are required to attend both the Materials Science student seminar and the invited MME/ML research seminar each week.** These seminars are viewed as a professional activity and are an important part of your graduate education experience. Do not register for the seminars, as the

extra unit will cause a problem with meeting your other scheduling requirements. The Materials Science Graduate Student Seminars meet on Wednesdays at 4:00 PM in HH202 and the Materials Research Seminars are on Thursdays at 4:00 PM in HH202. Snacks and beverages are served in the back of the classroom prior to the seminars. These seminars are an excellent time to meet the speakers in person, as well as interact with other Material Science students. If you work off campus, please see Professor David Olson about the seminar requirements.

Seminar presenter, topic and abstract will be posted to the web, displayed in posters distributed around Hill Hall, and emailed to each student at least one week in advance.

**You will be expected to present at least one seminar each year.** A schedule for the semester will be posted on the web and emailed to Materials Science students. Please email Connie Sanford with the Title and Abstract at least two weeks in advance. If you have scheduling problems making it difficult to attend seminars, or you are part-time, see Professor David Olson at Hill Hall 305 to discuss your particular situation.

### *Safety*

Materials Science research can be dangerous. High temperatures, noxious chemicals, and high mechanical forces are normal operating parameters for the recovery and utilization of materials. Rigid adherences to safety practices are not only necessary for the well-being of the Departmental community, but are an important component of the educational process.

The Environmental Health and Safety Department, (EHS) 303-273-3316, is located in Chauvenet Hall, Room 194. EHS operates the chemical storage and distribution facility for procuring and storing laboratory reagents. Students must procure chemical regents through EHS and return unused chemicals to them. In addition, students are required to collect, securely store, and identify wastes generated in laboratories. The Department will arrange to have the wastes removed. Students working with nuclear materials are expected to take the radiation and nuclear handling courses and receive a CSM nuclear technician certificate before working with radiation emitting materials. (See Larry Grimm, EHS, x3573.)

EHS maintains a hazardous materials response team. The Spill Team is on call evenings and weekends and can be reached at x3316.

**Mandatory Training.** At the beginning of each semester, EHS presents a mandatory General Safety class for all incoming graduate students. Students who need access to chemical stores and waste collection services are provided additional training. You are required to attend the Safety Seminar held in your home department/division each year. It is important that you attend this seminar one semester prior to doing your research work.

**Safety Requirements:**

- **Always Wear Proper Protective Gear -** Painful accidents have happened to those researchers who did not have time to find safety glasses, hot coats, and other protective gear. Develop good safety habits and insist on them for people who work for or around you. Safety gear in all laboratories is a must!

- **Do not Work Alone -** When you are working with a potentially hazardous process, always be sure that there is a colleague in the vicinity. A few days saved in the completion of a thesis will not help if you are not around for graduation.

- **Think Safety -** A painful or fatal accident can spoil your whole day! Learn to use the laboratory equipment properly.

- **Be Environmentally Conscious -** According to EPA regulations, most chemicals regularly used in materials science research must be properly managed and disposed. Learn the correct chemical disposal procedures as early as possible and follow the laboratory guidelines. Each entering graduate student will receive an information package on chemicals and their proper disposal.

- **Get Help -** The time it takes to get emergency personnel on the scene can mean the difference in the life or death of a colleague. Each telephone in the building has a list of emergency numbers. Know where these numbers are located.

- **Do not Become Another Victim -** Some gaseous or electrical accidents involve multiple fatalities. Use the telephone to summon emergency aid and then equip yourself with appropriate protection, such as an oxygen mask, before going to the aid of another person.

- **Learn About Life-Saving Procedures -** Several people at CSM are alive today only because someone at the scene of the accident knew the appropriate response. Life saving courses such as CPR are available on campus.

- **Properly Respond to Fire Alarm** – Close your office or laboratory door and leave the building by the closest route indicated by nearest exit sign. Move at least 100 feet away from the building. Let others know that you have left the building. Leave the fire fighting to the emergency professionals.

## General Registration Requirements

### *How to Register*

1. Log onto Trailhead
2. Select the Self Service Banner button (upper right corner)
3. Click on the Student and Financial Aid tab
4. Choose the Registration link.
5. Select the Add/Drop link. Select the term. The system will ask you for your alternate pin that your advisor has provided.
6. Enter the CRN (course registration number) for each course you wish to register for.
7. If you receive an error (ex. Link error, Preq and Test Score, etc.), please visit the help menu for information.
8. Review your schedule.

Full-time registration for graduate students is 9 credit hours per term. Special cases outlined below include first-year international students who must receive special instruction to improve their language skills, and students who have completed most of their credit-hour requirements and are working full time on their thesis.

Full-time graduate students may register for an overload of up to 6 credit hours (up to 15 credit hours total) per term at no increase in tuition. Subject to written approval by their advisor and department head or division director, students may register for more than 15 credit hours per term by paying additional tuition at the regular part-time rate for all hours over 15. The maximum number of credits for which a student can register during the summer is 12.

Students may register at less than the required full-time registration, subject to the minimum registration requirements defined below, except for students meeting any of the following conditions.

- International students subject to immigration requirements. This applies to international students holding J-1 and F-1 visas.
- Students receiving financial assistance in the form of graduate teaching assistantships, research assistantships, fellowships or hourly contracts.
- Students enrolled in academic programs that require full-time registration. Refer to the degree program sections of the bulletin to see if situation this applies to your particular program.
- Students for whom any one of these conditions apply must register at the appropriate full-time credit hour requirement.

If not required to register full-time, to remain in good standing, students must register continuously each fall and spring semester. Summer registration is not required for non-thesis students to remain in good standing.

### *Eligibility for Thesis (Reduced) Registration*

In addition to completing prescribed course work and defending a thesis, students in thesis-based degree programs must complete a research or engineering design experience under the direct supervision of their faculty advisor. Master's students must complete a minimum of 6 hours of research credit, and doctoral students must complete a minimum of 30 hours of research. While completing this experience, students will register for research credit under course numbers 705 (M.S.) or 706 (Ph.D.) as appropriate. Faculty will assign grades indicating satisfactory or unsatisfactory progress based on their evaluation of the student's work.

To be eligible for this reduced full-time registration consideration (4 credit hours), students must satisfy the following requirements:

- For M.S. students, completion of 30 hours of course and research credits combined.
- For Ph.D. students, completion of 72 hours of course and research credits combined.
- For all students, having approved Admission to Candidacy forms on file in the Graduate Office, within the first week of the semester you are applying for reduced thesis registration.
- Candidates for thesis-based degrees may not use more than 12 credit hours per semester in determining eligibility for thesis registration.

Transfer credits that have been accepted toward the degree count toward the 30 or 72 hour requirement. Students who are eligible for thesis registration will be considered full time if they are registered for 4 credit hours of research under course numbers 705 (M.S.) or 706 (Ph.D.) as appropriate. Faculty will assign thesis grades indicating satisfactory or unsatisfactory progress based on their evaluation of the student's work.

### *Registration Requirements for Summer and Field Appointments*

ALL Graduate Assistant and Graduate Hourly Appointees WORKING TOWARD DEGREE REQUIREMENTS (i.e., doing research or completing coursework) during the Summer or Field sessions (i.e., May through August) ARE REQUIRED TO REGISTER for research credits (705 or 706). There are no exceptions to this registration requirement.

Research Assistant Appointments: By definition Research Assistants are presumed to be working toward degree and, therefore, MUST REGISTER during the summer semester. The required minimum registration for a Research Assistant appointed during the summer term is three (3) credits of research. To insure research appointees have access to the appropriate campus services including building access, Health Center, Recreation Center, etc., Research Appointees MUST REGISTER for the required research credits BY THE LAST DAY OF REGISTRATION FOR THE FIELD TERM. All Research Appointees are assessed tuition at the normal summer tuition rates and Mandatory Fees at the "Thesis Research" rate.

If a student on a Research Assistant Appointment is also completing coursework during the summer or field terms, the Appointee MUST REGISTER FOR THESE COURSES IN

ADDITION to the required three credits of research. The registration deadline for coursework registration is the normal deadline for the field or summer session course. Tuition is assessed for both the required research and coursework credit hours at the normal summer and field rates. Mandatory Fees incurred by students completing both research and coursework during the summer are assessed at the "Thesis Research" rate.

Teaching Assistant and Hourly Appointments: If a Graduate Teaching Assistant or Graduate Hourly Appointee is not working toward degree requirements at any time during the summer or field sessions (i.e., May through August), REGISTRATION during the summer or field terms IS NOT REQUIRED. Such appointees will, however, be subject to the TIAA-CREF payroll deductions.

Summer fees are not automatically assessed for students who do not register. So, unless students proactively indicate they want fees assessed, students working on Teaching Assistant or Hourly Appointments during the summer will not have access to university-provided services (e.g., Health Center, Recreation Center, etc.).

If a Teaching Assistant or Hourly Appointee is also working toward degree requirements during the summer or field terms (i.e., May through August), these appointees must register as appropriate.

Appointees completing research during the summer must register for at least one (1) credit hour of research. The registration deadline for this required research registration is the last day of registration for the FIELD TERM.

Students completing coursework must register for the appropriate courses by the appropriate field or summer registration deadline. Tuition is assessed for all credits in which a student is registered at the normal summer and field tuition rates. Mandatory fees incurred by students completing coursework are assessed at the appropriate field or summer rates. Mandatory fees incurred by students completing research are assessed at the "Thesis Research" rate.

Teaching Assistant or Hourly Appointees working toward degree during the summer by completing both research and coursework during the summer (i.e., May through August) are required to register for both research credit hours and course credit hours as defined above by the deadlines defined above. Tuition is assessed for both the required research and coursework credit hours at the normal summer and/or field rates. Mandatory fees incurred by students completing both research and coursework during the summer (i.e., May through August) are assessed at the "Thesis Research" rate.

Students required to register during the summer semester are responsible for all Mandatory fees incurred during the summer semester. These fees may, or may not be remitted as part of a Graduate Assistant Appointment. Students for whom registration is not required during the summer semester but who are working on campus may chose to pay mandatory fees at the "Thesis Research" rate. Payment of these fees provides students access to campus facilities including, but not limited to the Library, Health Center, Recreation Center, etc. during the entire summer (i.e., May through August). Requests for prorating of this voluntary fee payment will not be considered.

## Advisor/Thesis Committee/Thesis Defense Process

### *Selection of an Advisor*

Your acceptance letter establishes your advisor and funding (tuition, stipend, & fees). If you find it necessary to change your advisor, you may ask another faculty member associated with your focus area interest if they would serve as your advisor.

The advisor provides advice regarding the student's thesis direction, research, and selection of courses. He/she will also serve as a voting member of the student's Thesis Committee.

Advisors must be full-time members of the CSM faculty and must hold the rank of professor, associate professor, assistant professor, research professor, associate research professor or assistant research professor. Upon approval by the Graduate Dean, adjunct professors and off-campus representatives may be designated co-advisors.

### *Selection of a Research Project*

It is important to quickly identify a research topic. The initiation of a significant project normally requires a substantial amount of planning. Design of the experiments and ordering of equipment and supplies require lengthy time periods. If you wait until your course work is finished to start your research, you will find frustrating delays in your research and extra months added to your program.

### *The Thesis Committee/Proposal Process*

Students should have a thesis committee appointed by the end of their second semester. A Thesis Committee Chairperson is designated by the student at the time he/she requests the formation of his/her thesis committee. The chairperson is responsible for leading the meetings and for the paperwork connected with the thesis defense. The Chairperson cannot be the advisor or co-advisor and must be a full-time CSM faculty member.

Shortly after formation, the Committee will meet with the student to hear a thesis proposal about the course of study and thesis topic. The Committee and the student must agree on a satisfactory program. The student must obtain the Committee's approval of the written thesis proposal at least one semester prior to the thesis defense. Award of the Master's or Doctoral degree is contingent upon the student researching and writing a thesis acceptable to the student's faculty advisor and the Thesis Committee.

The purpose of your thesis committee is to provide you with guidance during the course of your program. While the advisor controls the direction of your research program, the other members of your committee may give very valuable assistance. After planning your research project, set up a meeting with your thesis advisor and committee to present your plan. A timetable for the completion of your thesis should be presented, discussed, and approved.

After securing agreement from each potential member, prepare the Thesis Committee Request form. (See Graduate web site.) This form is to be initialed by each committee member, signed by your thesis advisor and signed by the Program Lead Scientist. Once this form is completed, take the form

to the Graduate Specialist. The original form will be sent to the Graduate Office for approval by the Dean of Graduate Studies and Research and a copy will be put in your file and in your mailbox. After processing, the Grad Office will return an "official" stamped copy.

- The Master's Committee will have a minimum of three voting members including the student's advisor. ML committee members can be from allied departs. Off-campus members can serve either as voting members or in a non-voting capacity. CVs are needed for off campus members.
- The Doctoral Committee consists of five voting members. Two of these members will be the advisor and the focus area mentor (or appointed mentor substitute). At least one of the members will be in a department/division other than that of the advisor. The "member at large" will be suggested by the student and approved by the Dean of Graduate Studies. Off campus members require a CV be submitted with the thesis committee form. The Materials Science Program does not require a minor, so a "minor department" member is not required.

### *Steps for Defending Your Thesis*

Thesis-based Master's and Doctoral candidates must pass an oral defense of his/her thesis during the final semester of studies. Students must be registered at the time of defense. The oral defense will include an examination of material covered in the course work.

Several steps must be completed in setting up your defense. They are as follows:

1. Go to the Graduate School home web page and click on "Information for Current Students." You will find a number of forms that must be filled out, signed, and submitted on time during your last couple of semesters.

2. The forms listed below must be processed prior to your defense:
    a. Admission to Candidacy
    b. Advisor/Thesis Committee
    c. Graduation Application – electronic form goes directly to the Grad School.
    d. Thesis Defense Form

3. Actions to Take:
    - Plan a date and time with your advisor and thesis committee at least two or three weeks prior to the defense.
    - Reserve HH 300 (or other appropriate conference room) in the appointment book on Elaine Wolfschlag's desk in the main office.
    - Fill out the Thesis Defense Form, get signed, and give to Connie Sanford.
    - **Give a copy of your thesis to each committee member at least a week in advance (two weeks is preferable).**
    - Send an email to csanford@mines.edu with the date and time, plus the thesis title and a brief abstract, at least two weeks in advance. Connie will send back an electronic poster sample for your use to create your posters.
    - Create at least 5 posters containing the title, abstract, your name, time, and place. Post in Hill Hall at least a week in advance.

4. The Work Completion Form will be processed at the conclusion of your defense.

    a. **For MT Students**
    Do not fill out the Work Completion Form. Dr. Martin is responsible for preparing this form. He gives a package to the thesis defense chairman and the rest of the committee to sign. The signed Work Completion Form will be given to Connie. She will make copies and take the original to the Graduate Office. Check with your advisor in a few days after the defense to make sure that Connie got the Work Completion Form.

    b. **For ML Students**
    The process is basically the same as above, but Connie will prepare the Work Completion form. She will give that form and the other forms noted above to the chairman or advisor. Ask your chairman to give the signed forms to Connie for Department Head signature and processing.

**Note: Let Connie Sanford know if you plan to continue for a PhD. Unless you were admitted as a PhD candidate, you must apply for PhD status by going to "ApplyYourself" in the Graduate Office website and filling out the application form. The application does not require Letters of Recommendation (put in cat, dog, bird for the names). There is a $25 charge. Your admittance will depend upon the recommendation of your thesis committee after your defense.**

# Educational Program

## *Degrees Offered*

- Master of Science (Materials Science Thesis)
- Master of Science (Materials Science Non-Thesis)
- Doctor of Philosophy (Materials Science)

## *Program Description*

The interdisciplinary materials science program is a collaboration of the Departments of Chemical Engineering, Chemistry and Geochemistry, Metallurgical and Materials Engineering, Physics, Division of Engineering, Environmental Science and Engineering, and Mining Engineering. The range of disciplines provides a Materials Science degree within one of the fourteen focus areas.

The required **six** Materials Science core courses are:

MLGN500 - Processing, Microstructure, and Properties of Materials

MLGN512/MTGN412 - Ceramic Engineering

MLGN531/CHEN416 - Intro to Polymer Engineering

MLGN501/CHGN580 - Structure of Materials or CHGN505 Advanced Organic Chemistry

MLGN504/MTGN555 - Solid State Thermodynamics
or CHEN509 - Advanced Chemical Engineering Thermodynamics
or CHEN509 Advanced Chemical Engineering Thermodynamics

MLGN511 - Kinetic Fundamentals in Materials
or MTGN 548 Transformations in Metals
or MTGN556/MLGN 506 Transport in Solids
or CHGN585 Chemical Kinetics

Students who have taken the equivalent of any of the core courses listed and have not used the courses to fulfill requirements towards their B.S. degree may petition the Materials Science Graduate Committee for transfer credit.

### Master of Science Degree Program with Thesis

Requirements for obtaining a Master of Science Degree is the ability to perform research work as well as understand and apply the advanced concepts presented in graduate-level courses in your area of specialization. A Master of Science thesis, which is a report of original scientific research or development, is required for the completion of your degree. You will conduct your research project with the guidance of your advisor but must demonstrate independent thinking.

The Master of Science degree requires a minimum of 30 semester hours of acceptable course work and research credit including:

- 18 hours of Materials Science courses (must have completed the six core courses)
- 6 to 12 hours of thesis research credits depending on Focus Area requirements
- Submit a thesis and pass the Defense of Thesis examination before the Thesis Committee.

The degree requires completing a minimum of 18 hours of approved graduate course work. Up to nine hours of 400-level courses may be counted towards graduation. Up to nine hours of course work with a grade of "B" or better may be transferred from another recognized institution upon the approval of the Graduate Affairs Committee and the Graduate Dean. A total of 30 hours is needed for the Master of Science degree.

**Typical Timetable**

**1st Semester:** Begin course work; select research topic; appoint thesis committee: begin research.

**2nd Semester:** Present course work to committee; continue course work and research.

**2nd Year:** Complete course work and thesis; defend thesis.

The typical time to completion is 1 1/2 to 2 years.

**Master of Science Degree Program - Non-Thesis**

Master of Science degree program without thesis has been designed for engineers or scientists who are working in industry. The thesis requirement is replaced with the requirement that non-thesis students complete a Case Study. The industrial student, who most likely has technical laboratory or manufacturers experience, may find this program more suited to their employment responsibilities.

The non-thesis Master of Science degree requires a minimum of 30 semester hours of acceptable course work (which includes the 6 hours of MLGN599 Case Study) broke down as follows:

- 18 hours of Materials Sciences Core courses plus other courses as required by the specialty area. The specialty materials-related courses can be taken in preparation for the PhD qualifying process examination (usually taken in the second year of graduate school. Student must take at least 30 hours of gradable coursework (research credits do not count).
- 6 hours of case study credits. (Sign up for MLGN 599, Case Study Materials Science, using a paper form at the Registrar's Office). The student must successfully prepare and defend a case study report on a topic that is most likely supporting materials for the student's PhD thesis. The case study will require the student to perform an analysis of the way processing-structure-property-performance relationships affect materials development and how it will influence the future of materials design. A panel of three faculty members will attend the case study presentation. A faculty member will be selected to read and grade the report. The three faculty members will also make a recommendation on whether the student will be accepted into the Materials Science PhD Program.

A faculty member selected by the mentor of the Focus Area will advise students in the non-thesis option. Non-thesis students will be strongly encouraged to gain industrial or laboratory experience during the course of their studies through co-ops or other arrangements. Students must indicate their intent to pursue a non-thesis Master of Science at their initial enrollment in the Materials Science program. Permission to change tracks from thesis to non-thesis, or vice-versa, will be granted under some circumstances. It must be approved by your advisor and submitted for approval by the Graduate Affairs Committee.

**Conversion of Master Program to Doctor of Philosophy Degree Program**

An M.S. or M.S. Non-thesis student who wishes to continue to the PhD program must first defend his/her thesis or present his/her engineering case study report. The quality of the defense and research will be considered when the advisor and committee discuss the student's qualifications to enter the PhD program. The advisor or Committee Chair should submit a "Promotion to the PhD Program" form to the Materials Science Education Specialist. The form should clearly state that the student has met all the requirements of the Master of Science or Master of Science Non-thesis degree program (including checkout) and is qualified to be promoted to the PhD Program. This document is filled in the Department.

⇨ **New -** You must also fill out the Application form (ApplyYourself) on the Graduate School web site. If you completed your MS (either thesis or non-thesis) and are continuing on for a PhD to be entered into Banner for your new degree effort, you will need to apply online (abbreviated application) for the PhD program. For Letters of Recommendation – put in fictitious words like "cat", "dog", etc. Also, choose "off line." You must pay the fee of $25. Let Connie know in an email and she will notify Kay Leaman in the Grad Office. As long as your advisor has signed the form in the paragraph above, you will be accepted to the PhD program. This procedure creates the new record and allows the Grad School to generate an admission letter and change your status.

If it is your intention to get a PhD when you first apply to Materials Science, you will be dual listed as a MS/PhD graduate student. Until you complete your M.S. or M.S. Non Thesis, you are officially a Master degree student. Once you complete all the requirements for the M.S. (including checkout), the advisor and your thesis committee must recommend that you are qualified to continue to the PhD program based on the quality of your research and defense. Connie Sanford will process a Change of Degree Form asking the Graduate School to change your degree program. Once the Graduate School has processed this memo, you will be listed solely as a PhD Materials Science student.

**How to Change Your Degree Program**

If you signed up for a MS thesis-based degree and want to change to a non-thesis degree program or change from MT to ML, or make a Bulletin change, you must use the Degree Change form on the web. Fill out the first two questions and send it to Connie Sanford for OK and processing. Remember to discuss this issue with your advisor before you send Connie the form. You need to get the advisor's signature on the printed form.

**The Doctor of Philosophy Degree Program**

The Doctor of Philosophy degree is awarded to those students who have demonstrated unusual competence in their field. The recipient must produce an original contribution to the science and/or engineering of the chosen research field. You must display a deep understanding of that field and demonstrate the ability to apply this knowledge effectively toward the solution of new problems.

Doctoral study is a period of intensive study and research under the direction of the advisor and with the guidance of the Doctoral Committee appointed by the Graduate Dean. A series of formal steps have been established which will guide you and your advisor in assessing your progress. The steps are given below in order of completion.

The prerequisite for acceptance into the Materials Science PhD Program is completion of a science or engineering Master degree (with or without thesis) and completion of the Materials Science Core courses with a grade of B or better (or evidence that the course content of these courses had been taken in previous courses) Transfer courses must be equivalent to the degree programs offered at CSM.. A candidate with a Master degree in Materials Science or related field from another institution can transfer into the program up to 30 course credit hours. You are expected to complete the Master of Science core courses and take the PhD Qualifying as described in the focus area flow sheets.

The Doctor of Philosophy degree requires a minimum of 72 hours of course and research credit (MLGN706) including:

- The fulfillment of the Materials Science core course requirements plus additional courses as required by the focus area and a minimum of 30 hours of research credit.
- A 2-hour oral qualifying process examination in the specialty area. The PhD candidate, in collaboration with their advisor and the focus area mentor, will organize a qualifying examination committee of 3-5 professors and schedule the exam. A minimum of 10 days prior to the exam, the candidate must submit an extended abstract describing his/her PhD research plans and preliminary results. This abstract should also discuss the major fundamental materials science themes of their research as they relate to the six ML core courses. During the exam, the candidate will deliver a 30-minute oral presentation on their research plans/preliminary results followed by up to 90 minutes of oral examination from the committee on the specifics of their proposed research as well as more general fundamental materials science and engineering questions appropriate to the candidates research area and the core materials science courses.

- Form a Ph.D. thesis committee by inviting at least five voting members, including your faculty advisor, two additional committee members, a minor representative, and one additional committee member selected by the student and advisor from outside the home department. Students may select off-campus members with either voting or non-voting status. Students must attach a brief resume of education and/or experience for off-campus committee members who hold voting status.

- Prepare and submit a thesis and pass a Defense of Thesis examination before the Thesis Committee. The defense of your thesis consists of an oral presentation and defense to your thesis committee and other interested faculty members and students.

**Typical Timetable:**

**1st Year:** Complete core course work, select research topic, form thesis committee, begin research, and start preparation for the qualifying process examination.

**2nd Year:** Written and/or Oral qualifying process examination/thesis proposal, completion of course work, continue thesis research.

**3rd Year:** Complete course work and thesis; defend thesis.

**4th Year:** Complete thesis; defend thesis.

For students with an acceptable MS degree, it normally takes 3 to 4 years to complete a PhD. For students with an acceptable BS degree, it normally takes 4 to 5 years to complete a PhD.

### *Fields of Research*

Advanced polymeric materials
Alloy theory, concurrent design, theory-assisted materials engineering, electronic structure theory
Applications of artificial intelligence techniques to materials processing and manufacturing, neural networks for process modeling and sensor data processing, manufacturing process control
Archaeometallurgy, industry and university partnerships
Aerospace materials
Bio materials and biocompatibility
Ceramic processing, modeling of ceramic processing
Characterization, thermal stability, and thermal degradation mechanisms of polymers
Chemical and physical processing of materials, engineered materials, materials synthesis
Chemical processing of materials
Chemical vapor deposition
Coating microstructural evolution
Coating materials and applications
Computational condensed-matter physics, semiconductor alloys, first-principles phonon calculations
Computer modeling and simulation
Control systems engineering, artificial neural systems for senior data processing, polymer cure monitoring sensors
Crystal and molecular structure determination by X-ray crystallography
Crystal mechanics
Dielectrics and ferrimagnetics
Drug-delivery system
Electrical energy generation materials
Electro deposition
Electro-microcopy analysis
Electrophotography
Experimental condensed-matter physics, thermal and electrical properties of materials, superconductivity, photovoltaics

Extractive and process metallurgy, electrochemical corrosion, synthesis of ceramic precursor powders and metal powders
Forging, deformation modeling, high-temperature material behavior
Fuel cell materials
Fullerene synthesis, combustion chemistry
Heat and mass transfer, materials processing
Heterogeneous catalysis, reformulated and alcohol fuels, surface analysis
High temperature materials
Intelligent automated systems, intelligent process control, robotics, artificial neural systems
Materials synthesis, interfaces, flocculation, fine particles
Materials for energy generation
Mathematical modeling of material processes
Mechanical metallurgy, failure analysis, deformation of materials, advanced steel coatings
Mechanics of Materials
Microbiologically influenced corrosion (MIC)
Molten salt processing
Mössbauer spectroscopy, ion implantation, small-angle X-ray scattering, semiconductor defects
Nano materials
Non destructive evaluation of defects and microstructures
Novel separation processes: membranes, catalytical membrane reactors, biopolymer adsorbents for heavy metal remediation of ground surface water
Nuclear materials and processing
Numerical modeling of particulate media, thermo-mechanical analysis
Optical properties of materials and interfaces
Phase transformations and mechanisms of microstructural change, electron microscopy, structure-property relationships
Physical metallurgy, ferrous and nonferrous alloy systems
Physical vapor deposition, thin films, coatings
Polymer chemistry and physics
Power electronics, plasma physics, pulsed power, plasma material processing
Process monitoring and control for composites manufacturing
Corrosion Science and Engineering
Processing and characterization of electro-ceramics (ferroelectrics, piezoelectrics, pyroelectrics, and dielectrics), glass-ceramics for electronic and structural applications
Pyrometallurgy, corrosion, materials synthesis, coatings
Reactive metals properties and processing of ceramics and ceramic-metal composites
Self-assembly and nanofabrication
Solidification and near net shape processing
Surface physics, epitaxial growth, interfacial science, adsorption
Thermodynamic modeling of ferroelectrics
Transformations, microstructure, deformation, fracture
Transport phenomena, mathematical modeling, kinetic properties of colloidal suspensions, and diffusion with chemical reaction
Weld metallurgy, materials joining processes

Welding and joining science
X-ray diffraction analysis

## Focus Area Flowcharts

Each Materials Science candidate will be required to select a focus area during his/her first semester from the fourteen interest areas listed below:

(1) Advanced Polymeric Materials – Professor Dan Knauss
(2) Ceramics – Professor Ryan O'Hayre
(3) Composites – Professor Ivar Reimanis
(4) Electronic Materials – Professor David Wood
(5) Joining Science – Professor Stephen Liu
(6) Mechanics of Materials – Professor Cristian Ciobanu
(7) Computational Materials Science – Professor Mark Eberhart
(8) Surface & Interfaces / Films & Coatings – Professor Scott Cowley
(9) Bio-materials – Professor Reed Ayers
(10) Nuclear Materials – Professor Marty Mataya
(11) Enviro-Material Science – Professor Ron Cohen
(12) Mining-Materials and Petroleum Materials Science – Professor Hugh Miller and Professor Ramona Graves
(13) Non Destructive Material Assessment – Professor David Olson
(14) Materials Chemical Processing (proposed) – Professor Patrick Taylor

The Graduate Affairs Committee will consider other focus areas, to allow for the Materials Science Program to be as individual a learning experience as possible.

### *Focus Area Chart Organization*

Courses required of all Materials Science graduate students are listed in the shaded box above the dashed line. The courses are selected to give the student a background in the entire spectrum of materials science focus areas. If a student comes into the program from another institution and can show proof that they have successfully completed a similar course, they can ask for transfer credits. This process is done in writing stating that the Program will give them credit for the course(s) they have taken. Similarly, if a student comes into the Program with a Master Degree and his transcript shows successful completion of the required courses, these courses are accepted.

### *Required Courses for all Focus Areas*

MLGN500. PROCESSING, MICROSTRUCTURE, AND PROPERTIES OF MATERIALS (I) A summary of the important relationships between the processing, microstructure, and properties of materials. Topics include electronic structure and bonding, crystal structures, lattice defects and mass transport, glasses, phase transformation, important materials processes, and properties including: mechanical and rheological, electrical conductivity, magnetic, dielectric, optical, thermal, and chemical. In a given year, one of these topics will be given special emphasis. Another area of emphasis is phase equilibria. Prerequisite: Consent of Instructor. 3 hours lecture; 3 semester hours.

MLGN501/CHGN580. STRUCTURE OF MATERIALS (II) Application of X-ray diffraction techniques for crystal and molecular structure determination of minerals, inorganic and organometallic compounds. Topics include the heavy atom method, data collection by moving film techniques and by diffractometers, Fourier methods, interpretation of Patterson maps, refinement methods, direct methods. Prerequisite: Consent of instructor. 3 hours lecture; 3 semester hours. Offered alternate years.

MLGN504/MTGN555. SOLID STATE THERMODYNAMICS (I) Thermodynamics applied to solid state reactions, binary and ternary phase diagrams, point, line and planar defects, interfaces, and electrochemical concepts. Prerequisites: consent of instructor. 3 hours lecture; 3 semester hours.

MLGN511. KINETIC CONCERNS IN MATERIALS PROCESSING I (I) Introduction to the kinetics of materials processing, with emphasis on the momentum, heat and mass transport. Discussion of the basic mechanism of transport in gases, liquids and solids. Prerequisite: MTGN352, MTGN361, MACS315 or equivalent. 3 hours lecture; 3 semester hours. Or MTGN548 TRANSFORMATIONS IN METALS; or MTGN556/MLGN506 TRANSPORT IN SOLIDS.

MLGN512. CERAMIC ENGINEERING (II) Application of engineering principles to nonmetallic and ceramic materials. Processing of raw materials and production of ceramic bodies, glazes, glasses, enamels, and cements. Firing processes and reactions in glass bonded as well as mechanically bonded systems. Prerequisite: MTGN348. 3 hours lecture; 3 semester hours.

MLGN531/CHEN416 POLYMER ENGINEERING AND TECHNOLOGY (II) Polymer fluid mechanics, polymer rheological response, and polymer shape forming. Definition and measurement of material properties. Interrelationships between response functions and correlation of data and material response. Theoretical approaches for prediction of polymer properties. Processing operations for polymeric materials; melt and flow instabilities. Prerequisite: CHEN307, MATH225, or consent of instructor. 3 hours lecture; 3 semester hours.

### *Acceptance Procedure for Material Science PhD Program*

The Master of Science thesis or case study and its presentation will be evaluated by the thesis or case study committee to assess the potential of the graduate student to continue for his/her Ph.D. in the Materials Science Program. The ability of the student to perform good scientific approach research, assess the data, and have an understanding of the fundamentals behind the thesis or case study will be assessed by the thesis or case study committee. The process will lead to one of the following three recommendations: (1) the student is granted entrance into the Material Science Ph.D. program (via a change form which is sent to the Graduate Office); or (2) the student is recommended for a terminal master degree (thesis or non-thesis); or (3) the student is excused from the graduate program.

### *The Dashed Line*

The courses below the dashed line represent the courses which best give the student a background in the focus area. With the help of his/her advisor, the student must choose five courses. These courses chosen will provide the student with the background required for successful passage of the PhD Qualifying examination.

### *The Mathematic Requirement*

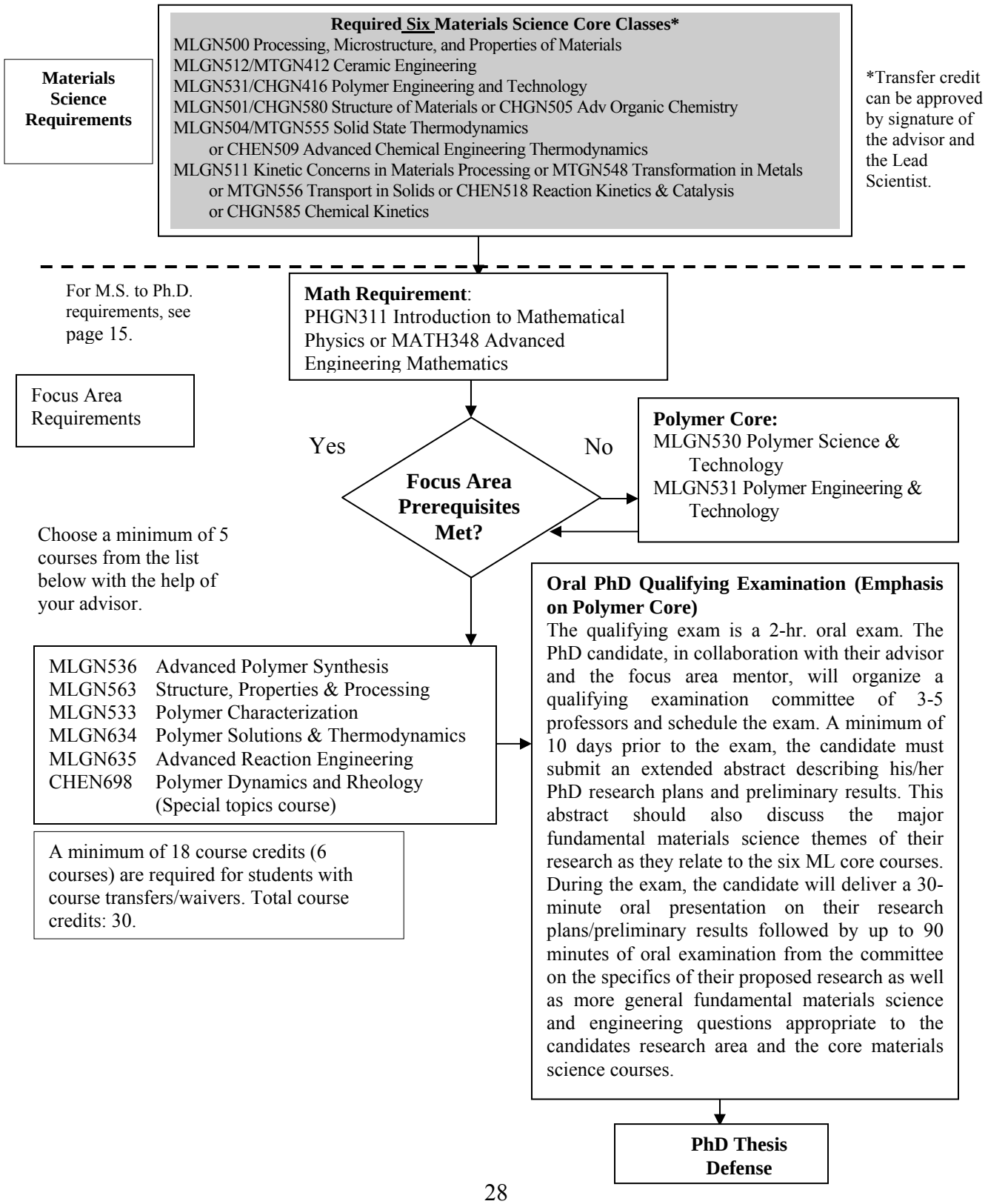
The advanced mathematic requirements are chosen by the focus area mentor to give the student the analytical background to be successful in the focus area courses.

### *The PhD Qualifier*

The PhD qualifier is standardized among all the focus areas. The qualifying exam is a 2-hr. oral exam emphasizing the focus area core subjects. A minimum of 10 days prior to the exam, the candidate must submit an extended abstract describing his/her PhD research plans and preliminary results. This abstract should also discuss the major fundamental materials science themes of their research as they relate to the five selected ML core courses. During the exam, the candidate will deliver a 30-minute oral presentation on the fundamentals relating to their specialty area and research. This presentation will be followed by up to 90 minutes of oral examination from the committee. Successful passing of the PhD qualifier examination results in the Committee recommending that the student be accepted as a PhD candidate. If the Committee feels that the student does not meet the qualifications, he/she will have an opportunity to retake the exam. Failing the second time, the student will be excused from the Materials Science PhD Program.

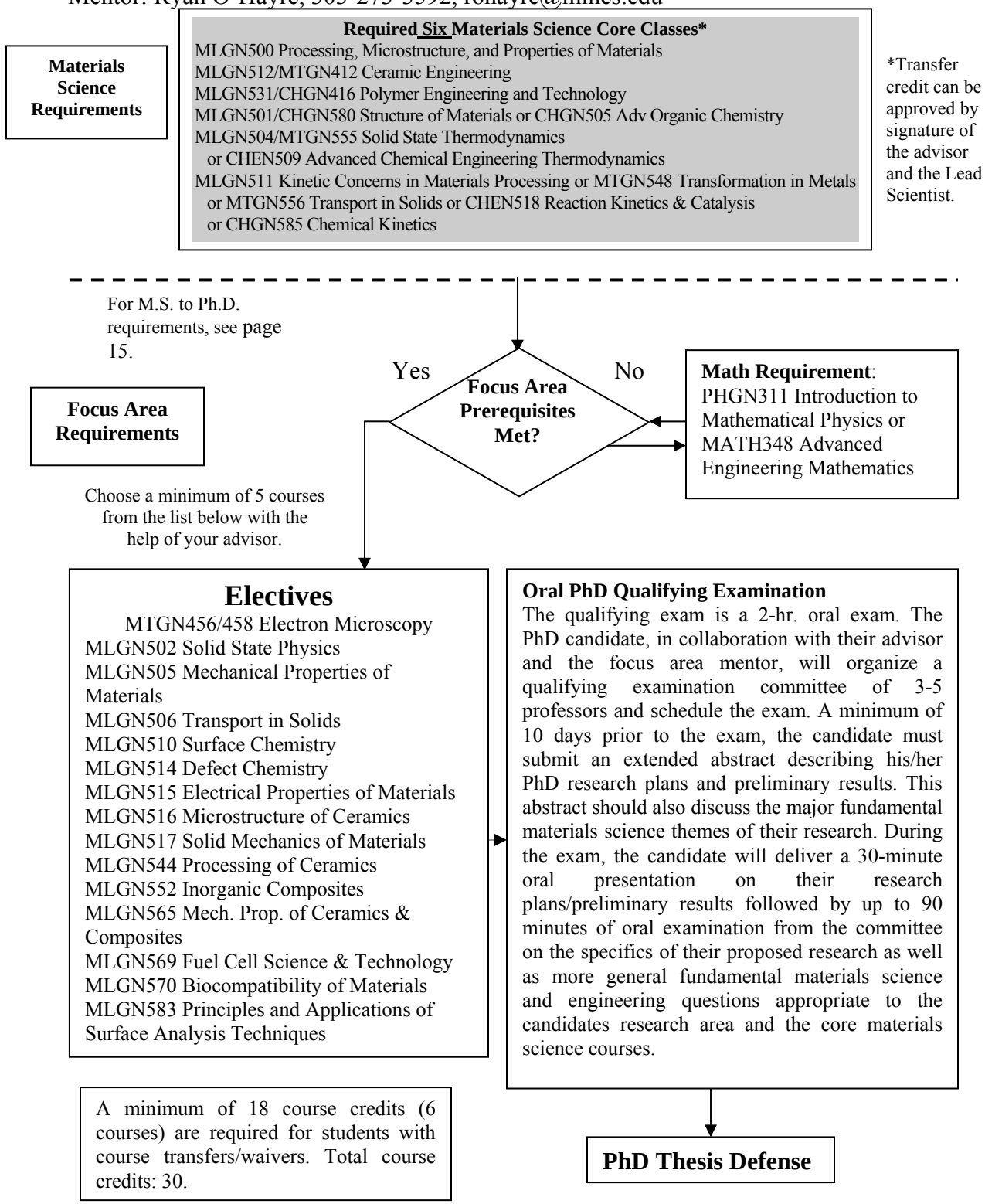
## *Advanced Polymeric Materials Focus Area*

Dan Knauss, 303-273-3625, dknauss@mines.edu



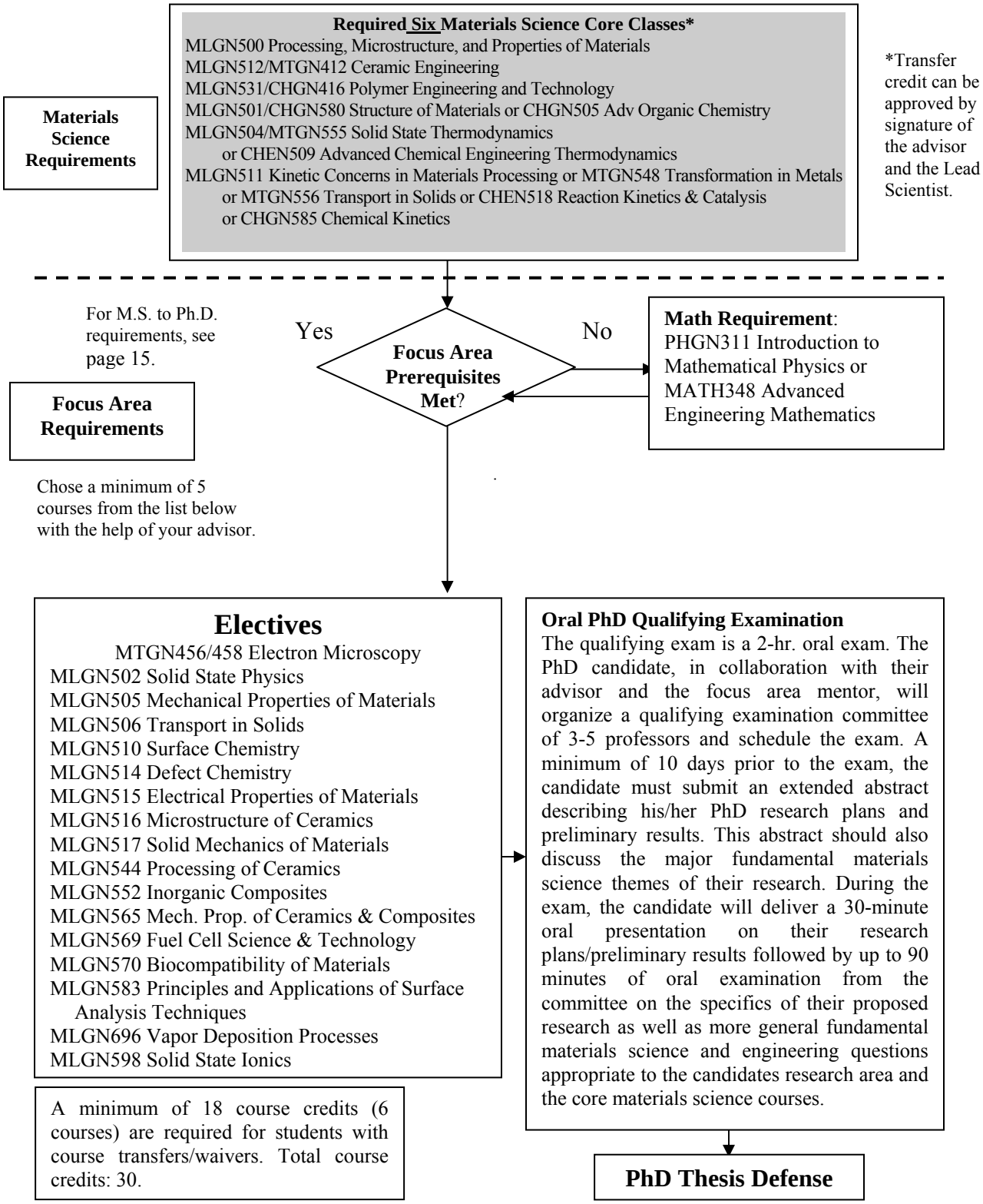
## *Ceramics Focus Area*

Mentor: Ryan O'Hayre, 303-273-3592, rohayre@mines.edu



## *Composite Focus Area*

Ivar Reimanis, 303-273-3549, ireimanis@mines.edu



## *Electronic Materials Focus Area*

David Wood, 303-273-3853, dmwood@mines.edu

**Materials Science Requirements**

**Required Six Materials Science Core Classes***

MLGN500 Processing, Microstructure, and Properties of Materials
MLGN512/MTGN412 Ceramic Engineering
MLGN531/CHGN416 Polymer Engineering and Technology
MLGN501/CHGN580 Structure of Materials or CHGN505 Adv Organic Chemistry
MLGN504/MTGN555 Solid State Thermodynamics
or CHEN509 Advanced Chemical Engineering Thermodynamics
MLGN511 Kinetic Concerns in Materials Processing or MTGN548 Transformation in Metals
or MTGN556 Transport in Solids or CHEN518 Reaction Kinetics & Catalysis
or CHGN585 Chemical Kinetics

*Transfer credit can be approved by signature of the advisor and the Lead Scientist

For M.S. to Ph.D. requirements, see page 15.

**Focus Area Prerequisites met?**

Yes

No

**Math:** PH311 (I), ML513 (1) or equivalent
**Quantum Mechanics:** PH320 (II) or equal
**Solid State:** ML502 (I) or equivalent
**Materials Processing:** MLGN535 (II)

**Focus Area Requirements**

Choose a minimum of 5 courses from either list below with the help of your advisor.

**Fundamentals and Applications**

**PH542** Solid State Devices
**PH544** Theory and Operation of Photovoltaic Devices
**PH550** (I) Nanoscale Physics and Technology
**PH598*** (I) Disordered and Complex Materials (I)
**MT514** (I) Defect Chemistry and Transport Processes in Ceramic Systems
**ML522** (II) Solid State Physics Applications & Phenomena
**ML509/CH523** (I) Solid State Chemistry
**MT415/ML515** (II) Electrical Properties & App Mat'ls
*Course number not yet fixed.
*Not all courses offered regularly; substitutions permitted*

**Characterization, Processing and Packaging**

**CH583/ML583** (II) Principals & Apps of Surface Analysis Techniques
**MT697** (I) Microstructural Evolution of Coatings & Thin Films
**MT453** (I) Principals of Integrated Circuit Processing
**ML550** (I) Statistical Process Control & Design of Experiments
**MT414/ML544** (II) Processing of Ceramics
**ML696** (II) Vapor Deposition Processes

**PhD Qualifying Process** This is a 2-hour oral PhD thesis proposal defense. The candidate, in collaboration with his/her advisor and the Electronic Materials mentor, will organize a committee in accordance with Graduate School requirements and schedule the exam. At least 10 days before the exam, the candidate must submit an extended proposal describing his/her PhD research plans and preliminary results. During the examination, the candidate will deliver a 30-minute oral presentation describing these, to be followed by up to 90 minutes of oral examination from the committee on the specifics of the proposed research as well as on more general fundamental materials science questions appropriate to the candidate's research area.

PhD Defense

A minimum of 18 course credits (6 courses) are required for students with course transfers/waivers. Total course credits: 30.

## *Joining Sciences Focus Area*

Mentor: Stephen Liu, 303-273-3796, sliu@mines.edu

**Materials Science Requirements**

**Required Six Materials Science Core Classes***

MLGN500 Processing, Microstructure, and Properties of Materials
MLGN512/MTGN412 Ceramic Engineering
MLGN531/CHGN416 Polymer Engineering and Technology
MLGN501/CHGN580 Structure of Materials or CHGN505 Adv Organic Chemistry
MLGN504/MTGN555 Solid State Thermodynamics
or CHEN509 Advanced Chemical Engineering Thermodynamics
MLGN511 Kinetic Concerns in Materials Processing or MTGN548 Transformation in Metals
or MTGN556 Transport in Solids or CHEN518 Reaction Kinetics & Catalysis
or CHGN585 Chemical Kinetics

*Transfer credit can be approved by signature of your advisor and the Lead

For M.S. to Ph.D. requirements, see page 15.

**Focus Area Requirements Met?** — Yes / No

**Math Requirement:**
MATH348 Advanced Engineering Mathematics or PHGN311 Introduction to Mathematical Physics

**Focus Area Requirements**

Choose a minimum of five courses from either the Processing or Materials & Characterization Track listed below with the help of your advisor.

**Processing Electives**

MTGN475/477 Metallurgy of Welding
MTGN580 Advanced Welding Metallurgy *
MTGN581 Welding Heat Sources & Interactive Controls *
MTGN582 Mechanical Properties of Welded Joints
MTGN583 Principles of Nondestructive Testing and Evaluation
MTGN584 Non-Fusion Joining Processes
MTGN587 Physical Phenomena of Welding and Joining Processes
EGGN442 Finite Element Methods for Engineers (*)
MTGN586 Design of Welded Structures and Assemblies (*)
EGGN444 Design of Steel Structures
EGGN400 Introduction to Robotics for the Minerals & Construction Industries

**Materials & Characterization Electives**

MLGN504/MTGN555 Solid-State Thermodynamics
MLGN506/MTGN560 Transport in Solids
MTGN548 Phase Transformations
MTGN557 Solidification
MLGN510/CHGN410 Surface Chemistry*
MLGN584/CHGN583 Principles & Applications of Surface Analysis Techniques
MTGN456/458 Electron Microscopy
MTGN560 Analysis of Metallurgical Failures
EGES532/MTGN545 Fatigue and Fracture (*)

**Qualifying Process Examination:** The qualifying exam is a 2 hr oral exam. The PhD candidate, in collaboration with their advisor and the mentor, will organize a qualifying examination committee of 3-5 professors and schedule the exam. The committee will be chaired by the track mentor. A minimum of 10 days prior to the exam, the candidate must submit an extended abstract describing his/her PhD research plans and preliminary results. This abstract should also discuss the major fundamental materials science themes of their research as they relate to the six ML core courses. During the exam, the candidate will deliver a 30 min oral presentation on their research plans/preliminary results, followed by up to 90 minutes of oral examination from the committee on the specifics of their proposed research as well as more general fundamental materials science and engineering questions appropriate to the candidate's research area and the core materials science courses.

A minimum of 18 course credits (6 courses) are required for students with course transfers/waivers. Total course credits: 30.

**PhD Defense**

## *Mechanics of Materials Focus Area*

Cristian Ciobanu, 303-384-2119, cciobanu@mines.edu

**Materials Science Requirements**

**Required Six Materials Science Core Classes***

MLGN500 Processing, Microstructure, and Properties of Materials
MLGN512/MTGN412 Ceramic Engineering
MLGN531/CHGN416 Polymer Engineering and Technology
MLGN501/CHGN580 Structure of Materials or CHGN505 Adv Organic Chemistry
MLGN504/MTGN555 Solid State Thermodynamics
or CHEN509 Advanced Chemical Engineering Thermodynamics
MLGN511 Kinetic Concerns in Materials Processing or MTGN548 Transformation in Metals
or MTGN556 Transport in Solids or CHEN518 Reaction Kinetics & Catalysis
or CHGN585 Chemical Kinetics

*Transfer credit can be signature of the advisor and the Lead Scientist.

For M.S. to Ph.D. requirements, see page 15.

**Focus Prerequisites Met?**

Yes

No

**Math**: ML513 (I) or MA348 or equivalent
**Mechanics:** EG320 (I,II) or equivalent
**Materials:** SYGN202 Eng. Materials Systems
MT390 Mats. & Manuf. Processes

**Focus Area Requirements**

Choose a minimum of five courses from either list below with the help of your advisor.

**Mechanics**

EGGN422/ML517 Adv. Mechanics of Mat'ls
EGGN540 (I) Continuum Mechanics
EGGN544 (II) Solid Mech of Nonlinear Mat'ls
MTGN564 (I) Const. Model. of Mat'ls Behavior
EGGN542 (II) Finite Elements for Engineers
EGGN545 (II) Boundary Elements Methods
EGGN535 (II) Intro. to Discrete Elements
EGGN413 (I/II) Computer Aided Engineering
EGGN528 (I) Computational Biomechanics
EGGN559 (II) Mechanics of Particulate Media
EGGN642 (I) Adv. Finite Elements for Engineers
PHGN505 (I) Classical Mechanics I
PHGN530 (II) Statistical Mechanics
EGGN598 (I/II) Nanomechanics

**Materials**

MTGN445/MLGN 505 (I) Mech. Behavior Materials
MTGN543 (I) Theory of Dislocations
EGGN598 (I/II) Micro Evolution & Model Mat'ls
MTGN546 (I) Creep & High Temp. Mat'ls
MTGN545 (I) Fracture & Fatigue
MTGN416 (II) Properties of Ceramics
MTGN452 (I/II) Ceramic & Metal Mat. Composites
MTGN564 (I) Constitutive Modeling Mat'ls Behavior
MTGN565 (I) Mech. Props. Ceramics & Comps.
MTGN697 (I) Micro. Evolution Coatings & Films
MTGN552 (S) Inorganic Matrix Composites
MTGN463 (I) Polymer Engineering
CHGN515/MLGN503 (I) Chemical Bonding Mat'ls.
CHGN523/MLGN509 (I) Solid State Chemistry
PHGN440/MLGN502 (II) Solid State Physics

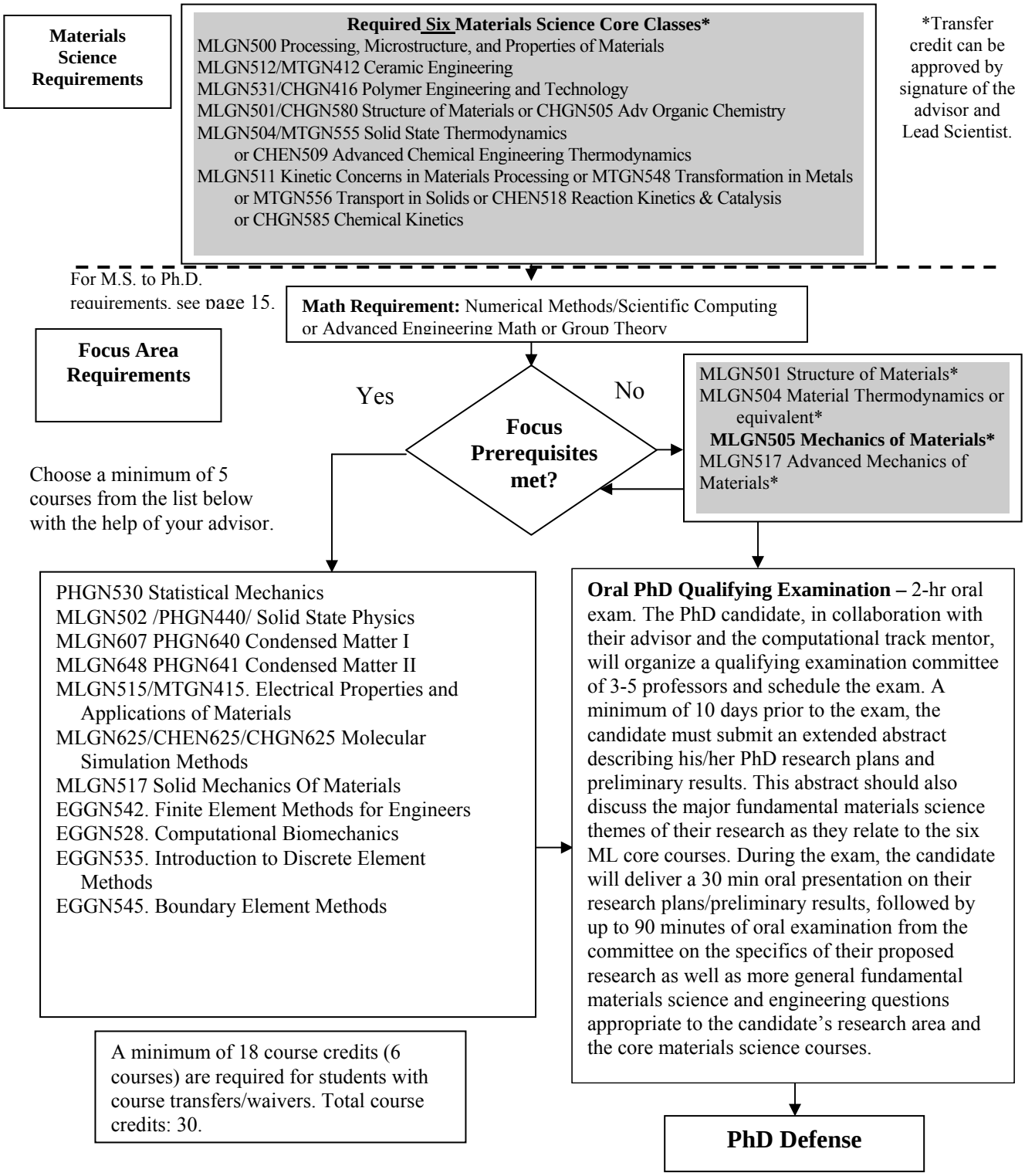
**Oral PhD Qualifying Examination –** 2-hr oral exam. The PhD candidate, in collaboration with their advisor and the mechanics of materials track mentor, will organize a qualifying examination committee of 3-5 professors and schedule the exam. A minimum of 10 days prior to the exam, the candidate must submit an extended abstract describing his/her PhD research plans and preliminary results. This abstract should also discuss the major fundamental materials science themes of their research as they relate to the six ML core courses. During the exam, the candidate will deliver a 30 min oral presentation on their research plans/preliminary results, followed by up to 90 minutes of oral examination from the committee on the specifics of their proposed research as well as more general fundamental materials science and engineering questions appropriate to the candidate's research area and the core materials science courses.

A minimum of 18 course credits (6 courses) are required for students with course transfers/waivers. Total course credits: 30.

**PhD Defense**

## *Computational Materials Science Focus Area*

Mark Eberhart, 303-273-3726, meberhar@mines.edu



## *Surface & Interfaces/Films & Coatings/Corrosion Focus Area*

Scott Cowley, 303-273-3638, scowley@mines.edu

**Materials Science Requirements**

**Required Six Materials Science Core Classes***

MLGN500 Processing, Microstructure, and Properties of Materials
MLGN512/MTGN412 Ceramic Engineering
MLGN531/CHGN416 Polymer Engineering and Technology
MLGN501/CHGN580 Structure of Materials or CHGN505 Adv Organic Chemistry
MLGN504/MTGN555 Solid State Thermodynamics
or CHEN509 Advanced Chemical Engineering Thermodynamics
MLGN511 Kinetic Concerns in Materials Processing or MTGN548 Transformation in Metals
or MTGN556 Transport in Solids or CHEN518 Reaction Kinetics & Catalysis
or CHGN585 Chemical Kinetics

*Transfer credit can be approved by signature of the advisor and the Lead Scientist.

**Math Requirement**: MLGN513 or equivalent.

For M.S. to Ph.D. requirements, see page 15.

**Focus Area Requirements**

**Focus Area Prerequisites met?**

Yes

No

**Physical Chemistry:**
CHGN351 or equivalent
CHGN353 or equivalent
**Physics:**
PHGN300 or equivalent

Choose a minimum of 5 from the two lists below with the help of your advisor.

**Distributed Core**

*****MLGN510/CHGN510 (Surface Chemistry)
*MLGN583/CHGN 583 (Prin. of Surface Anal.)
*MLGN 502/PHGN 440 (Solid State Physics)
*MTGN697 (Microstructural Evolution of Coatings and Thin Films)
MTGN696/MLGN696 (Vapor Deposition Processes)

**Electives**

CHGN584/ML584 (Fundamentals of Catalysis)
MTGN451 (Corrosion Engineering)
MTGN456/MTGN458L (Electron Microscopy and Lab)
MTGN551 (Advanced Corrosion Engineering)
MTGN554 (Oxidation of Metals)
MTGN555/MLGN504 (Solid State Thermo)
MLGN502/PHGN440 (Solid State Physics)
MLGN 522/PHGN441 (Solid State Physics Appl.)
PHGN542 (Solid State Devices)

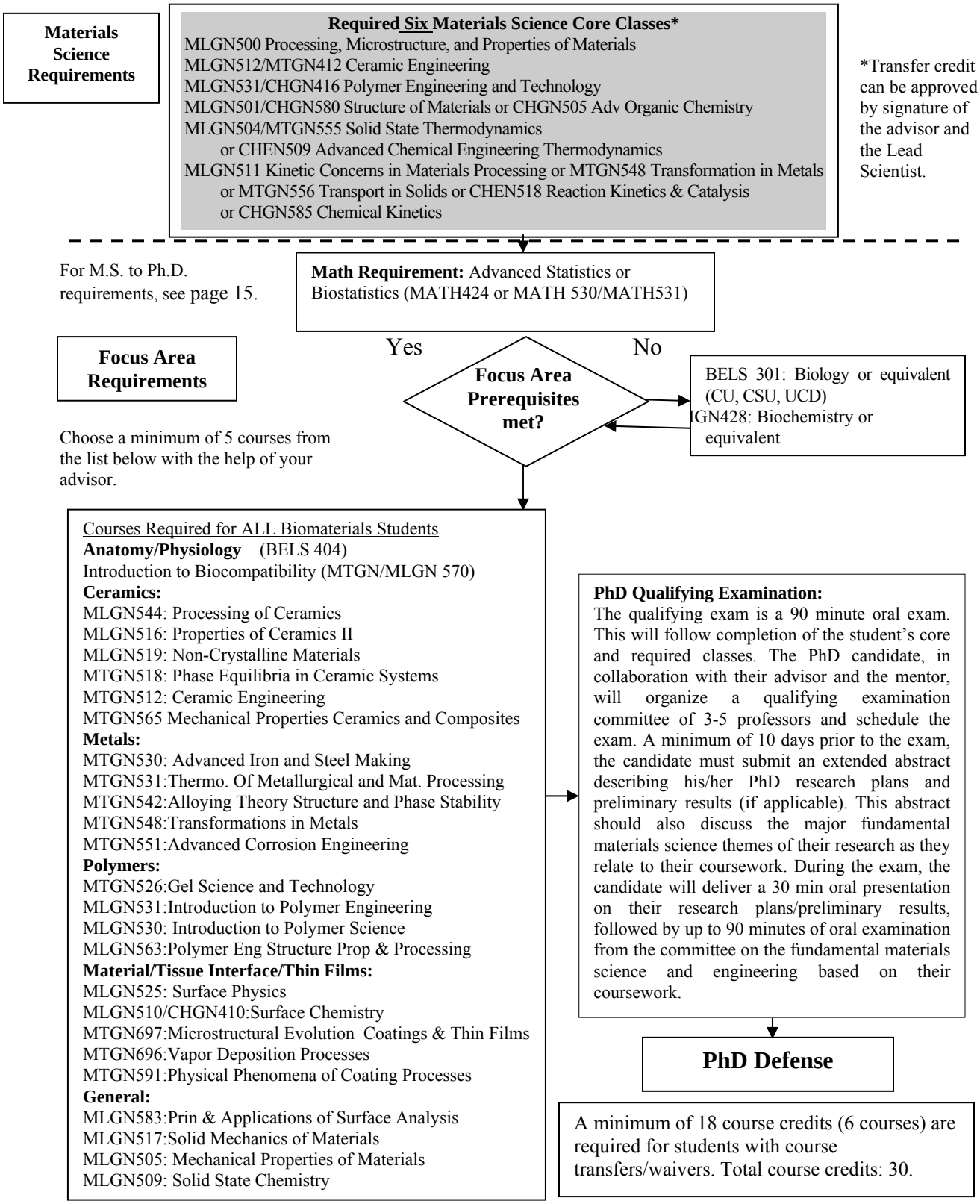
**Oral PhD Qualifying Examination –** 2-hr oral exam. The PhD candidate, in collaboration with their advisor and the mentor, will organize a qualifying examination committee of 3-5 professors and schedule the exam. A minimum of 10 days prior to the exam, the candidate must submit an extended abstract describing his/her PhD research plans and preliminary results. This abstract should also discuss the major fundamental materials science themes of their research as they relate to the six ML core courses. During the exam, the candidate will deliver a 30 min oral presentation on their research plans/preliminary results, followed by up to 90 minutes of oral examination from the committee on the specifics of their proposed research as well as more general fundamental materials science and engineering questions appropriate to the candidate's research area and the core materials science courses.

A minimum of 18 course credits (6 courses) are required for students with course transfers/waivers. Total course credits: 30.

**PhD Defense**

## *Biomaterials Focus Area*

Mentor: Reed Ayers, x2337, ruayers@mines.edu@mines.edu



## *Nuclear Materials Focus Area*

Marty Mataya, x2013, mmataya@mines.edu

**Materials Science Requirements**

**Required Six Materials Science Core Classes***

MLGN500 Processing, Microstructure, and Properties of Materials
MLGN512/MTGN412 Ceramic Engineering
MLGN531/CHGN416 Polymer Engineering and Technology
MLGN501/CHGN580 Structure of Materials or CHGN505 Adv Organic Chemistry
MLGN504/MTGN555 Solid State Thermodynamics
or CHEN509 Advanced Chemical Engineering Thermodynamics
MLGN511 Kinetic Concerns in Materials Processing or MTGN548 Transformation in Metals
or MTGN556 Transport in Solids or CHEN518 Reaction Kinetics & Catalysis
or CHGN585 Chemical Kinetics

*Transfer credit can be approved by signature of the advisor and the Lead Scientist.

For M.S. to Ph.D. requirements, see page 15.

**Focus Area Prerequisites met?**

Yes

No

**Math:** PHGN311 Introduction to Mathematical Physics or Math 348 Advanced Engineering Mathematics

**Focus Area Requirements**

** Required Focus Area Courses
Choose minimum of 3 other courses

PHGN422 Nuclear Physics**
MTGN593 Nuclear Materials Science & Engineering**
PHGN590 Introduction to Nuclear Reactor Physics
PHGN598 Reactor Design
PHGN598 Nuclear Reactor Experiments
MNGN598 Introduction to Uranium Milling & Mining
CHGN 510 Nuclear and Istopic Geochemistry
ESGN598 Stewardship of Nuclear Resources
MTGN Chemical Processing of Nuclear Materials
ESGN510 Environmental Radiochemical Processes
ESGN501 Environmental Risk Assessment
MTGN456/MTGN458 electron microscopy
MLGN502 Solid State Physics
MLGN505 Mechanical Properties of Materials
MLGN506 Transport in Solids
MLGN510 Surface Chemistry
MLGN514 Defect Chemistry
MLGN516 Microstructure of Ceramics
MLGN517 Solid Mechanics of Materials
MLGN544 Processing of Ceramics
MLGN552 Inorganic Composites
MLGN565 Mech Prop of Ceramics and Composites
LAIS598 Nuclear Power and Public Policy

**Oral PhD Qualifying Examination**

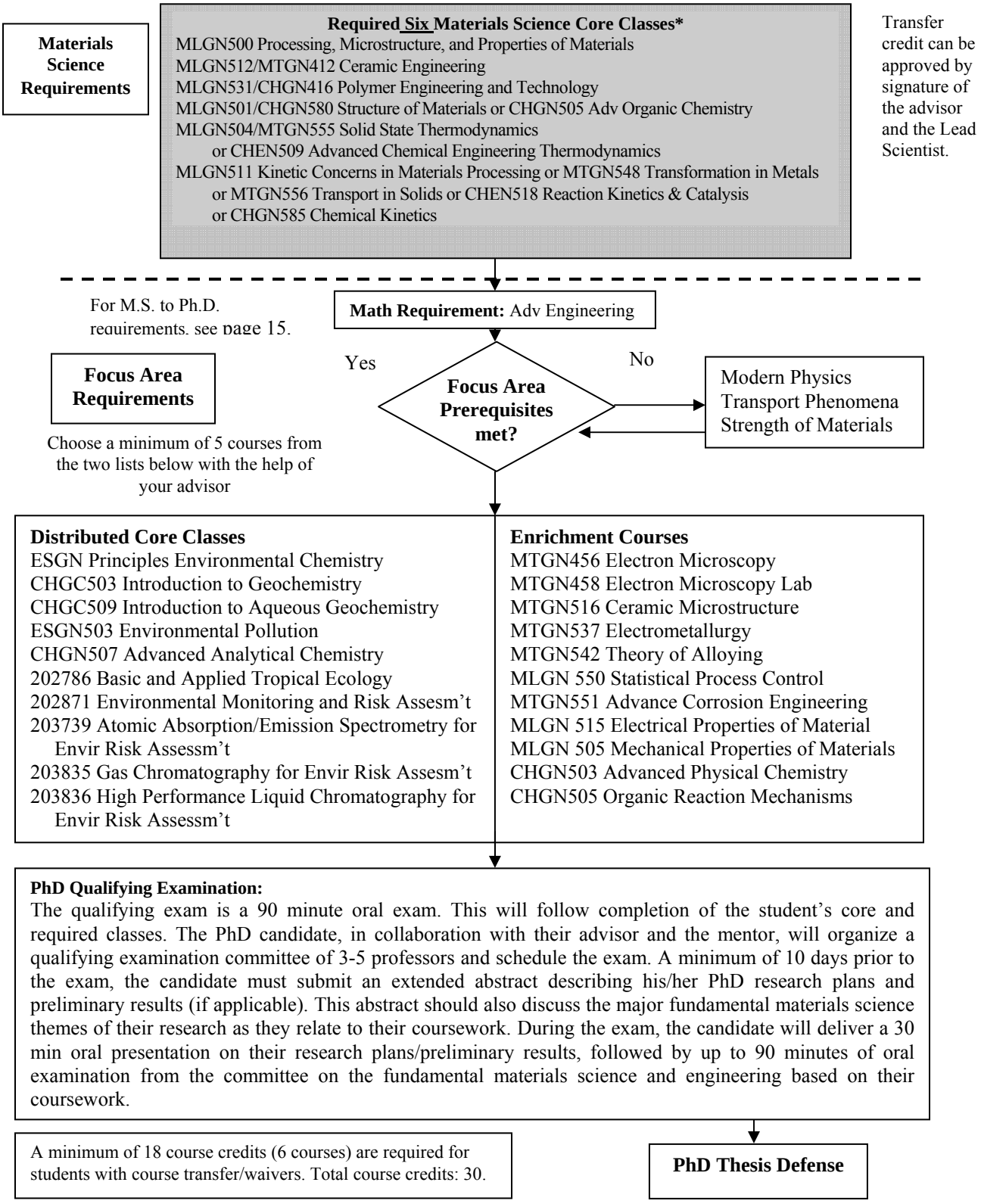
The qualifying examination is a 2hr oral exam. The PhD candidate, in collaboration with his/her advisor and the mentor, will organize a qualifying examination committee of 3-5 professors and schedule the exam. A minimum of 10 days prior to the examination, the candidate must submit an extended abstract describing his/her PhD research plans and preliminary results. This abstract should discuss major fundamental material science findings of their research. During the exam, the candidate will deliver a 30 minute oral presentation of their research plans/preliminary results followed by a 90 minutes oral examination by the committee. The committee will ask questions about the research as well as general fundamental materials science and engineering questions appropriate to the candidate's research and about the core materials science courses.

**PhD Thesis Defense**

A minimum of 18 course credits (6 courses) are required for students with course transfer/waivers. Total course credits: 30.

## *Enviro-Material Focus Area*

Ron Cohen, x3613, rcohen@mines.edu



## *Mining Materials and Petroleum Materials Science Focus Area*

Mentors: Hugh Miller (x3558, hbmiller@mines.edu) and Ramona Graves (x3746, rgraves@mines.edu)

**Materials Science Requirements**

**Required Six Materials Science Core Classes***

MLGN500 Processing, Microstructure, and Properties of Materials
MLGN512/MTGN412 Ceramic Engineering
MLGN531/CHGN416 Polymer Engineering and Technology
MLGN501/CHGN580 Structure of Materials or CHGN505 Adv Organic Chemistry
MLGN504/MTGN555 Solid State Thermodynamics
or CHEN509 Advanced Chemical Engineering Thermodynamics
MLGN511 Kinetic Concerns in Materials Processing or MTGN548 Transformation in Metals
or MTGN556 Transport in Solids or CHEN518 Reaction Kinetics & Catalysis
or CHGN585 Chemical Kinetics

*Transfer credit can be approved by signature of the advisor and the Lead Scientist.

For M.S. to Ph.D. requirements, see page 15.

**Math Requirement: TBD**

**Focus Area Requirements**

Yes / No

**Met Focus Area Requirements?**

**MNGN 510:** Fundamentals of Mining & Resource Development or
**MNGN 210**: Introduction to Mining

Choose a minimum of 5 courses from the lists below with the help of your advisor.

**Required to complete two of the following courses**

| | |
|---|---|
| MNGN508 | Advanced Rock Mechanics |
| MNGN512 | Surface Mine Design |
| MNGN516 | Underground Mine Design |

**Required to complete three additional courses from the following list:**

| | |
|---|---|
| MNGN414 | Mine Plant Design |
| MNGN431 | Mining and Metallurgical Environment |
| MNGN433 | Mine Systems Analysis |
| MNGN444 | Explosives Engineering |
| MNGN503 | Mining Technology for Sustainable Development |
| MNGN508 | Advanced Rock Mechanics |
| MNGN512 | Surface Mine Design |
| MNGN515 | Mine Mechanization & Automation |
| MNGN516 | Underground Mine Design |
| MNGN539 | Advanced Mining Geostatistics |
| MNGN590 | Mechanical Excavation in Mining |
| MNGN598 | Special Topics in Mining |

**PhD Qualifying Examination:**
The qualifying examine is a 2-hr oral exam. The Ph.D. candidate, in collaboration with their advisor and the mentor, will organize a qualifying examination committee of 3-5 professors and schedule the exam. A minimum of 10 days prior to the exam, the candidate must submit an extended abstract describing his/her Ph.D. research plans and preliminary results. This abstract should also discuss the major fundamental materials science themes of their research as they relate to the six ML core courses. During the exam, the candidate will deliver a 30 minute oral presentation on their research plans/preliminary results, followed by up to 90 minutes of oral examination from the committee on the specifics of their proposed research as well as more general fundamental materials science questions appropriate to the candidate's research area.

A minimum of 18 course credits (6 courses) are required for students with course transfer/waivers. Total course credits: 30.

**PhD Thesis Defense**

## *Non-Destructive Materials Assessment Focus Area*

**Mentor: David Olson x3955**

**Materials Science Requirements**

**Required Six Materials Science Core Classes***

MLGN500 Processing, Microstructure, and Properties of Materials
MLGN512/MTGN412 Ceramic Engineering
MLGN531/CHGN416 Polymer Engineering and Technology
MLGN501/CHGN580 Structure of Materials or CHGN505 Adv Organic Chemistry
MLGN504/MTGN555 Solid State Thermodynamics
or CHEN509 Advanced Chemical Engineering Thermodynamics
MLGN511 Kinetic Concerns in Materials Processing or MTGN548 Transformation in Metals
or MTGN556 Transport in Solids or CHEN518 Reaction Kinetics & Catalysis
or CHGN585 Chemical Kinetics

*Transfer credit can be approved signature of the advisor and the Lead Scientist.

For M.S. to Ph.D. requirements, see page 15.

**Math Requirement:** PHGN311 Intro to Mathematical Physics or Math 348 Adv. Engineering Mathematics

**Focus Area Requirements**

Yes / No

**Focus Area Prerequisites Met?**

**Modern Physics:** PH320 (II)
**Circuits:** EGGN382 or PHGN215

Choose 5 courses from the list below with the help of your advisor.

MTGN542 – Alloy Theory
MTGN583 – Principles of NDT
MTGN598 – E&M Property Assessment
MTGN598 – Elastoacoustic Wave Analysis
MTGN456 - Electron Microscopy
MLGN502/PHGN440 - Solid State Physics
MLGN505 - Mechanical Properties of Materials
PHGN361 – Intermediate E&M
MLGN506/MTGN556 - Transport in Solids
MLGN517 - Solid Mechanics of Materials
MTGN560 – Analysis of Metallurgical Failures
MTGN598 – Defects in Solids
MTGN541 – Introductory to Physics of Metals
MTGN381 - Phase Equilibria

A minimum of 18 course credits (6 courses) are required for students with course transfer/waivers. Total course credits: 30.

**Oral PhD Qualifying Examination** The qualifying exam is a 2 hr oral exam. The PhD candidate, in collaboration with their advisor and the ND materials assessment track mentor, will organize a qualifying examination committee of 3-5 professors and schedule the exam. A minimum of 10 days prior to the exam, the candidate must submit an extended abstract describing his/her PhD research plans and preliminary results. This abstract should also discuss the major fundamental materials science themes of their research as they relate to the six ML core courses. During the exam, the candidate will deliver a 30 min oral presentation on their research plans/preliminary results, followed by up to 90 minutes of oral examination from the committee on the specifics of their proposed research as well as more general fundamental materials science and engineering questions appropriate to the candidate's research area and the core materials science courses.

**PhD Thesis Defense**

## *Materials Chemical Processing Focus Area (In preparation)*

**Mentor: Patrick Taylor, 303-384-2130, prtaylor@mines.edu**

**Materials Science Requirements**

**Required Six Materials Science Core Classes***

MLGN500 Processing, Microstructure, and Properties of Materials
MLGN512/MTGN412 Ceramic Engineering
MLGN531/CHGN416 Polymer Engineering and Technology
MLGN501/CHGN580 Structure of Materials or CHGN505 Adv Organic Chemistry
MLGN504/MTGN555 Solid State Thermodynamics
or CHEN509 Advanced Chemical Engineering Thermodynamics
MLGN511 Kinetic Concerns in Materials Processing or MTGN548 Transformation in Metals
or MTGN556 Transport in Solids or CHEN518 Reaction Kinetics & Catalysis
or CHGN585 Chemical Kinetics

*Transfer credit can be approved signature of the advisor and the Lead Scientist.

For M.S. to Ph.D. requirements, see page 15.

**Focus Area Requirements**

**Focus Area Prerequisites Met?**

Yes

No

**Math Requirement:**
MTGN334 Chemical Processing of Materials
MTGN351 Metallurgical and Materials Thermodynamics
MTGN461 Transport Phenomena and Reactor Design for Metallurgical and Materials Engrs.

Choose 5 courses from the list below with the help of your advisor.

**Required Courses:**

MTGN530 Advanced Iron & Steel Making
MTGN531 Thermodynamics of Metallurgical and Materials Processing
MTGN532 Particulate Materials Processing-Commininution and Physical Separation
MTGN533 Particulate Materials Processing-Applied Separation
MTGN535 Pyrometallurgical Processes
MTGN538 Hydrometallurgical
MTGN631 Transport Phenomena in Metallurgical and Materials Systems

A minimum of 18 course credits (6 courses) are required for students with course transfer/waivers. Total course credits: 30.

**Oral PhD Qualifying Examination** The qualifying exam is a 2 hr oral exam. The PhD candidate, in collaboration with their advisor and the ND materials assessment track mentor, will organize a qualifying examination committee of 3-5 professors and schedule the exam. A minimum of 10 days prior to the exam, the candidate must submit an extended abstract describing his/her PhD research plans and preliminary results. This abstract should also discuss the major fundamental materials science themes of their research as they relate to the six ML core courses. During the exam, the candidate will deliver a 30 min oral presentation on their research plans/preliminary results, followed by up to 90 minutes of oral examination from the committee on the specifics of their proposed research as well as more general fundamental materials science and engineering questions appropriate to the candidate's research area and the core materials science courses.

**PhD Thesis Defense**

# APPENDIX A

### *Forms Online*

## Required Forms

Forms and specific deadline dates for the current semester may be found online at http://gradschool.mines.edu/info_current_students_LtrDean.htm. Thesis and graduation deadlines are also in the current Graduate Student Handbook. Individual academic departments may also have specific deadlines.

| Title | When to Submit | Where to Submit |
|---|---|---|
| Thesis Committee Form | Upon selection of committee and advisor | Graduate Coordinator's Office (HH206) →Sent to Office of Graduate Studies |
| Admission to Candidacy Form | Upon successful presentation of thesis research proposal. Must be submitted in 1st week of semester for reduced registration. | Graduate Coordinator's Office (HH206) →Sent to Office of Graduate Studies |
| Graduation Application | Within 5 weeks of the beginning of the semester in which you expect to graduate | Office of Graduate Studies |
| Thesis Defense Request Form | At least two weeks before defense date; and at least six weeks before graduation (See Connie in HH206 for a list of exactly what you need to do to defend your thesis.) | Graduate Coordinator's Office (HH206) →Stays in your file. |
| Signature Sheet Signed and included as page ii in the thesis, following the successful defense and prior to the final format approval by OGS | | Office of Graduate Studies |
| Statement of Work Completion Form | Prior to delivery of required thesis copies for binding and preservation | Graduate Coordinator's Office (HH206) →Sent to Office of Graduate Studies |
| Checkout Card | Obtained from OGS prior to delivery of required thesis copies for binding and preservation | Signed by all and submitted to the Graduate Office – A copy must remain in your file. |

| | | |
|---|---|---|
| Proprietary Research Agreement *(if applicable)* | Submitted with delivery of thesis copies for binding and preservation | Signed by Dean of Graduate Studies and then submitted to Arthur Lakes Preservation Unit |
| Copyright Application Form *(if applicable)* | | Submitted at any time Library of Congress Copyright Office |

*Just a reminder that a copy of every prepared form should be given to the Graduate Education Specialist for your file prior to submittal.*

# APPENDIX B

## Master of Science Program Check List

*Please note that many of the forms listed below have deadlines for submittal. Consult your student handbook for dates.*

(1) Student/Advisor/Mentor meeting completed on: _____

(2) Deficiency Courses: _____

_____

_____

(3) Courses to be presented for degree: _____

_____

_____

(4) Thesis Committee Request Form completed on:

Advisor _____

Member _____

Member _____

(5) Thesis Title: _____

(6) Application for Admission to Candidacy completed on: _____

(7) Graduation Application completed on (within 5 weeks after start of semester you expect to graduate): _____

(8) Colorado Residency achieved on: _____

(9) Thesis Defense Request form completed on: _____

(10) Thesis defense date: _____

(11) Thesis corrections completed on: _____

(12) Signatures on Completion Form and Thesis Title Page: _____

(13) Check-out Card completed* on: _____

***Please note, check out card will not be signed without return of all thesis books from the thesis library.***

# Appendix C

## Doctoral Program Check List

*Please note that many of the forms listed below have deadlines for submittal. Consult your student handbook for dates.*

(1) Student/Advisor/Mentor meeting completed on: _____

(2) Deficiency Courses required: _____

_____

_____

_____

(3) Courses to be taken for Degree: (Per discussion with focus area mentor and the advisor.) _____

_____

_____

_____

(4) Thesis Committee Request Form submitted on: _____

Advisor: _____

Co-advisor: (if applicable) _____

Member: _____

Member: _____

Member: (from dept. other than advisor's) _____

Member-at-Large: _____

External Member: (if applicable) _____

(5) Colorado Residency achieved on: _____

(6) PhD Qualifying Examination completed on: _____

(7) Oral Qualifying process/Thesis Research Proposal scheduled for and completed on: _____

(8) Application for Admission to Candidacy completed on: _____

(9) Graduation Application completed on (within 5 weeks after start of semester you expect to graduate): _____

(10) Thesis Title: _____

(11) Thesis Defense Request Form completed on: _____

(12) Thesis Defense completed on: _____

(14) Thesis corrections completed on: _____

(15) Signatures on Completion Form and Thesis Title Page: _____

(16) Check-out Card completed on*: _____

(17) Commencement Date: _____

***Please note, check out card will not be signed without return of all thesis books from the thesis library.***

# Appendix D

### *Required Courses For The PhD Qualifying Process Exam*

Please arrange a meeting between yourself, your advisor, and the mentor of your Focus Area regarding which courses you will be responsible for when you take your Qualifying Process Exam in your second year. This meeting needs to be held within two weeks of the start of the student's first semester.

Meeting Date: _____

Advisor: _____

Mentor: _____

Required Courses:

_____

_____

_____

_____

_____

# Appendix E

## Thesis Writer's Guide

The Colorado School of Mines Graduate School publishes a thesis guide for graduate students. This guide is meant as a set of minimum guidelines for producing the final copies of the thesis. This is a style guide only and does not contain information about how to present a good technical document. Pick up your guide from the Graduate School.

The student should check with his/her advisor to see if there are special requirements within the department. Also, the student's thesis committee may have preferences on how they would like the materials presented.

Thesis writers are encouraged to communicate with their advisor, thesis committee, and the Graduate School to be sure that they are following the required guidelines for producing their thesis.

In addition, the student should be sure they understand the process of registering for thesis credit, thesis grades, and refunds for finishing the thesis before the end of the semester.

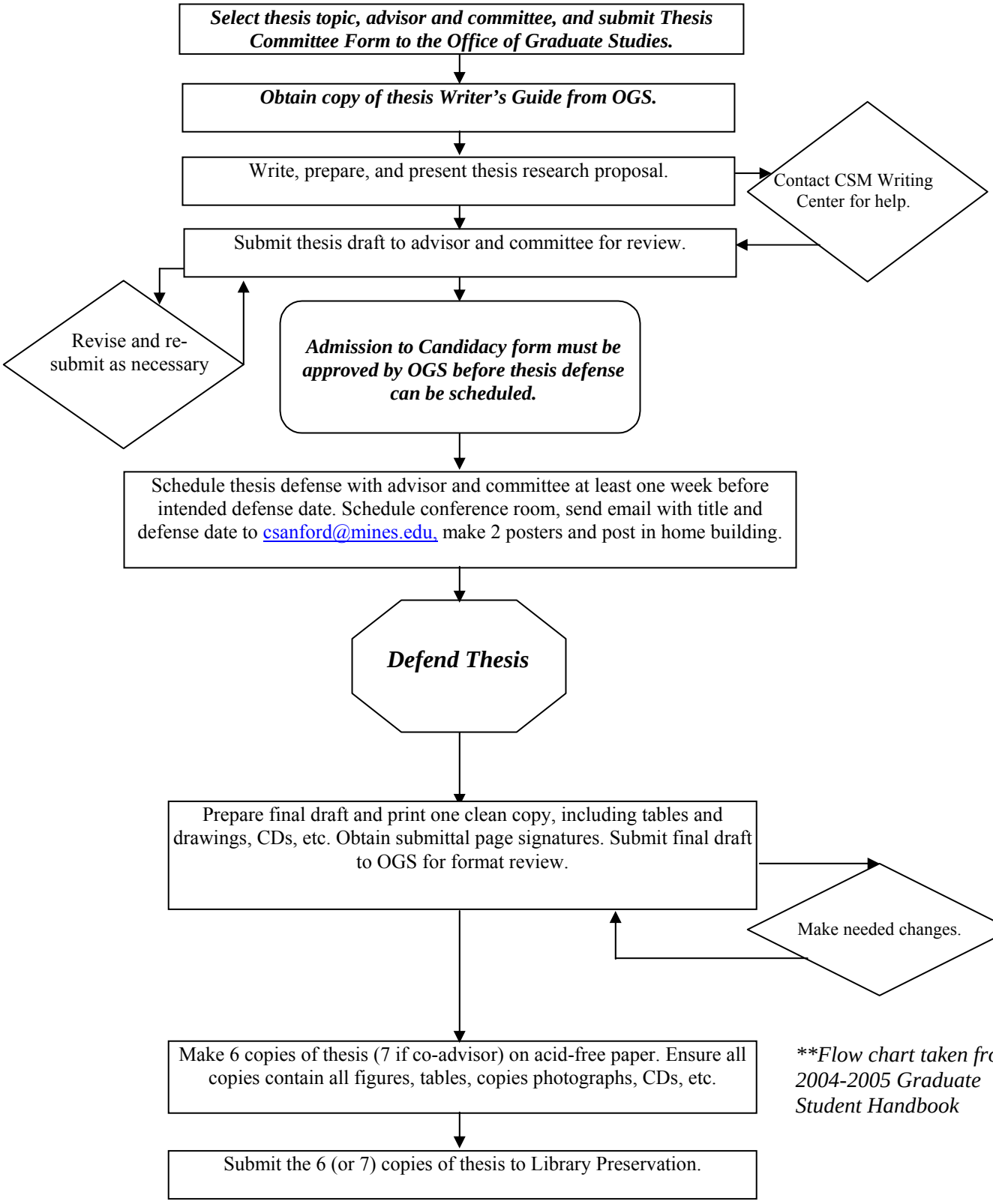
### *Signature Page - Thesis*

Please use the sample below for the signature page of your thesis.

_____

Professor John J. Moore, Director
Materials Science Program

### *Thesis Flowchart/Checklist*




***Flow chart taken from the 2004-2005 Graduate Student Handbook*

# Appendix F

## *Information on the Establishment of Domicile for Tuition Purposes*

### Colorado Residency for Tuition Purposes

The CSM Admissions Office makes the initial determination of a student's residency status for tuition purposes. After a student is enrolled at CSM, the Registrar's Office is responsible for residency decisions. The determination of residency is generally based on the student's intent to make his/her permanent domicile in Colorado, not simply to obtain the lower, in-state tuition rate.

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 CSM for these students during their first year of study only. After the first year of study, these students may be responsible for paying the difference between resident and non-resident tuition.

TIP: The decision on whether or not to grant residency is based in part on parental support of the student. A student may not receive more than $650 a year, including funds borrowed on their behalf.

BEWARE! One of the requirements for gaining residency is that the student be considered emancipated and receiving no support from her or his parents. This may be in direct conflict with the financial aid system, which will not consider a student emancipated or self-supporting unless he or she meets the appropriate criteria. Even though a parent may declare the student emancipated as part of the residency qualification process, this does not automatically meet the federal and CSM requirements for a student to be considered self-supporting.

The State of Colorado partially subsidizes the cost of tuition for all students whose domicile, or permanent legal residence, is in Colorado. Each CSM student is classified as either an "in-state resident" or a "non-resident" at the time of matriculation. These classifications are based upon information furnished by each student on his or her application for admission to CSM.

The specific requirements for establishing residency for tuition classification purposes are prescribed by state law (Colorado Revised Statutes § 23-7-101, *et seq*.). Because Colorado law governs Colorado residency status, the fact that a student might not qualify for in-state status in any other state does not guarantee in-state status in Colorado. Moreover, it is presumed that a student classified as a non-resident at the time of matriculation who seeks to establish Colorado domicile while registered at CSM seeks Colorado domicile solely for tuition purposes. The student can rebut this presumption and be deemed an in-state resident only by a showing of *clear and convincing* evidence of his or her eligibility for this status.

### Petitioning for In-State Tuition Classification

A continuing, non-resident student who believes that he or she has become eligible for in-state tuition due to events that have occurred subsequent to his or her initial enrollment may file a Petition for In-state Tuition Classification with the Registrar's Office. This petition is due in the Registrar's Office no later than the first day of the semester for which the student is requesting in-state residency status. The

Registrar will make the initial decision regarding the student's eligibility for in-state status. This decision can be appealed by petition to the Tuition Classification Review Committee. For more information about this process, please contact the Registrar's Office.

**Summary of Statutory Requirements**

In-state or resident status requires domicile in Colorado for one year or more immediately preceding the beginning of the semester for which in-state status is sought. "Domicile" means a person's true, fixed, and permanent home and place of habitation. It is the place where the individual intends to remain and to which he intends to return when he leaves. Establishment of a new domicile in Colorado occurs when an individual is physically present in Colorado and does not intend to return to the state in which he or she was formerly domiciled (or to acquire a domicile at some other place outside of Colorado). The domicile of an un-emancipated minor is the same as the parent or guardian with whom he or she resides. Students over the age of 22 years, students commencing a post-baccalaureate degree program, and emancipated minors are qualified to determine their own domicile. "Emancipated minor" means a minor whose parents have entirely surrendered the right to the care, custody and earnings of such minor, are under no duty to support the minor and have made no provision for the support of such minor.

**Domicile**

Pursuant to Colorado law, the following may be considered as **evidence of Colorado domicile**:

- Payment of Colorado income tax;
- Employment in Colorado (other than that normally provided to students on a temporary basis by CSM, or other temporary employment);
- Ownership of residential real property in Colorado;
- Graduation from a high school located in Colorado;
- Continued residence in the state of Colorado during periods when not enrolled as a student, or during periods between academic sessions;
- Acceptance of future permanent employment in the state of Colorado;
- Vehicle registration in Colorado;
- Voter registration in Colorado; and
- Any other factor peculiar to the individual that tends to establish the necessary intent to make Colorado a permanent home.

No single factor or combination of these factors may be considered *conclusive* evidence of domicile. Moreover, because domicile is defined as a true, fixed and *permanent* home, individuals who are present in Colorado on a temporary basis, e.g., for the purpose of completing a degree, cannot establish domicile by merely taking these actions.

The following may be considered as evidence of domicile in another state:

- Failure to comply with any Colorado law imposing a mandatory duty upon a domiciliary or resident of this state

- Maintenance of a home in another state
- Payment of income tax in a state other than Colorado
- Prolonged absence from Colorado, except for the purpose of military or governmental service, when the absence is due to a temporary relocation required as a condition of employment, or when the student has been out of state for less than three years and his or her parent or legal guardian was and continues to be a resident of Colorado;
- Return to one's former residence for a substantial portion of the time during periods when not enrolled as a student, or between academic sessions;
- Vehicle registration in another state; and
- Any other factor peculiar to the individual that tends to establish the fact that his or her permanent home is in another state.

**Emancipation**

The following may be considered as **evidence of emancipation**, although none of these items, other than marriage, may be considered as *conclusive* evidence of emancipation:

- An affidavit from the parents stating their relinquishment of any claim or right to the care, custody, and earnings of the minor, as well as the duty to support the minor;
- Entry into the military service by the minor;
- Failure of the parents to provide financial support to the minor, coupled with the evidence that the minor is independently able to meet his or her own financial obligations, including the cost of his or her education;
- A minor's marriage; and any other factor peculiar to the individual that tends to establish that he or she is independent of his or her parents.

The following may be considered as **evidence of non-emancipation**:

- A parent's claiming of a minor as a dependent for the purpose of income taxation;
- A student's receipt of and reliance on gifts, loans, or proceeds from an inter vivos trust regardless of the date of receipt thereof and whether such funds are proffered by the parents, another relative, or a friend of the minor;
- The minor's continued residence in the home of his or her parents (temporary visits excepted); and any other factor peculiar to the individual that tends to establish that he or she lacks independence and is dependent upon his or her parents.

**Military Personnel**

Members of the United States armed forces may be eligible to obtain in-state status after being domiciled in Colorado for 12 continuous months and complying with the tuition classification statutes or, notwithstanding the length of residency, upon moving to Colorado on a permanent change-of-station basis. Moreover, any member of the military forces of Canada stationed in Colorado, or the dependent of any such member, qualifies for in-state tuition status at any institution of higher education in this

state. However, no member of the Canadian military will be deemed to be stationed in this state unless he maintains a full-time principal residence in Colorado. Moreover, in-state tuition status for Canadian military personnel or their dependents will terminate at the conclusion of the current semester upon transfer to any station outside of this state.

**Foreign Nationals**

A foreign national, notwithstanding an intention to return to his or her country of origin or ineligibility to establish domicile in the United States pursuant to federal law, is eligible for classification as an in-state student after one year of Colorado residence if the primary purpose of the foreign national's residence in Colorado is other than for his or her education or for the education of a family member. The Colorado Commission on Higher Education has determined which nonimmigrant alien categories are subject to this provision. Non-immigrants in the following categories cannot qualify for in-state tuition: F-1, F-2, H-3, H-4 (if the visa holder is the spouse or child of an H-3), J-1 and J-2 (if the J-1 visa holder is a student or trainee), M-1, and M-2. Individuals who are lawful permanent residents or who are admitted as refugees are eligible to establish domicile for tuition purposes.