University of Arizona
Department of Materials Science and Engineering

Materials Science and Engineering
Graduate Student Handbook
2025

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1. Introduction

The University of Arizona is a Research I university and ranks 21st among public universities and 34th among all universities in the U.S. in research activities. The Materials Science and Engineering Department (MSE) offers an intensely interdisciplinary research environment with activities spanning photonic and electronic materials and processes, computational materials science, high temperature ceramics and composites, energy materials, glass chemistry and physics, biomaterials, polymer and hybrid materials science, metallurgy, and conservation science. MSE faculty embrace this multidisciplinary environment, holding joint appointments across the University in such programs as Optical Sciences, Electrical and Computer Engineering, Chemical Engineering, Chemistry, Physics, BIO5, and Anthropology. These interactions greatly enhance opportunities for student research to extend into these overlapping fields through active collaboration. Our academic program contains approximately 60 graduate students engendering a close-knit environment and engaged faculty.

The MSE Graduate Student Handbook is intended to provide you with information on the degree requirements and procedures for pursuing a graduate degree in the Department of Materials Science and Engineering at the University of Arizona. Students are expected to consult with the graduate program coordinator in the MSE Department, Elsa Morales about policies or procedures. Students should also become familiar with information provided by the UA Graduate College at: http://grad.arizona.edu/new-and-current-students and catalog information at: http://catalog.arizona.edu/

2. Program Information

The MSE Department offers the following advanced degrees in Materials Science and Engineering: Master of Science (M.S.) with thesis and non-thesis option and the Doctor of Philosophy (Ph.D.) The department also offers an accelerated master's program (AMP leading to an M.S. non-thesis degree) as well as a Master of Engineering in Innovation, Sustainability and Entrepreneurship. The M.S non-thesis degree is intended for students who are seeking a broader education in the MSE field through focused coursework. The M.S. degree thesis option is intended for students who are interested in specialized areas of research. The degree is pursued in close association with a faculty member involved in the research topic. The Masters of Engineering in Innovation, Sustainability, and Entrepreneurship is geared toward students and industry professionals who are interested in the translation and transfer of technologically-promising research discoveries into sustainable technologies and processes. It offers a combination of business-oriented classes and engineering courses to help engineers bridge the gap between innovative ideas and sustainable economic development strategies.

MSE graduates are trained to seek employment in a number of different sectors such as industry, national laboratories and consulting firms. Additionally, Ph.D. graduates may seek postdoctoral positions and academic positions in universities.

3. Faculty and Staff Roster

MSE Faculty

Name	Title	Phone	Office	Email
Cazacu, Oana	Prof.	520-626-0445	Mines M125E	oanacazacu@arizona.edu
Corral, Erica	Prof.	520-621-8115	Harsh 338C	elcorral@arizona.edu
Deymier, Pierre	Prof.			deymier@arizona.edu
Hahn, Horst	Prof.			hhahn@arizona.edu
Holmes, Alex	Asst. Prof. Practice		Harsh 16B	aholmes2@arizona.edu
Kim, Brian	Asst. Prof.	520-621-0271	Harsh 33D	briankim@arizona.edu
Kim, Minkyu	Assoc. Prof.	520-621-2767	Mines 143	minkyukim@arizona.edu
Latypov, Marat	Asst. Prof.	520-626-3542	Mines 153	latmarat@arizona.edu
Loy, Douglas	Prof.	520-609-6021	Harsh 338B	daloy@arizona.edu
Lucas, Pierre	Prof.	520-322-2311	Mines 145	pierre@arizona.edu
Muralidharan, Krishna	Prof.	520-626-8997	Harsh 304C	krishna@arizona.edu
Mutlu, Zafer	Asst. Prof.	520-626-5164	Mines 147	zmutlu@arizona.edu
Potter, Barrett	Prof.	520-322-2303	Harsh 304B	bgpotter@arizona.edu
Revil-Baudard, Benoit	Asst. Prof.	520-626-0578	Harsh 338A	revil@arizona.edu
Tin, Sammy	Prof./Head	520-626-5372	Harsh 103A	tin@arizona.edu
Uhlmann, Donald	Prof.	520-621-6070		dru1@arizona.edu
Wessman, Andrew	Assoc. Prof.	520-621-8121	Mines M125D	wessman@arizona.edu
Yan, Xiaodong	Asst. Prof.	520-621-6075	Mines 151	xyan@arizona.edu

MSE Emeritus Faculty (Retired)

Name	Email
Poirier, David	poirierd@arizona.edu
Raghavan, Srini	srini@arizona.edu
Vandiver, Pamela	vandiver@arizona.edu

MSE Staff

Name	Title	Phone	Office	Email
Emptage, Nancy	Admin. Assoc.	520-626-1243	Harsh 103	emptagen@arizona.edu
Morales, Elsa	Program Coordinator, Sr.	520-626-6762	Mines 131	elsam@arizona.edu
Solis, Jesus	Res. Engr. Mech. Tech.		Harsh 16	jsolis1@arizona.edu

4. Faculty Research

The MSE Department offers the following MSE is a constantly evolving interdisciplinary area of study and faculty develop new areas of research, funding, and usually develop teaching tools or classes that reflect this creativity. The competencies of the faculty and the areas they cover are given below, with faculty listed in alphabetical order. See resumes for further information.

Oana Cazacu's research interests and expertise are in constitutive modeling of plasticity, damage and fracture of materials from single crystal to engineering scale. She has developed widely used anisotropic models for the inelastic behavior of materials at various length-scales and strain-rate regimes with applications ranging from manufacturing processes to impact and hypersonics virtual testing and evaluation.

Erica Corral researches high temperature materials and ceramics. She is also an expert in bulk multifunctional high-temperature ceramic nanocomposites reinforced with single-walled carbon nanotubes for enhanced toughness in ceramics. She was recognized as a University of Arizona Distinguished Scholar in 2016.

Pierre Deymier has expertise in computational materials science and engineering, phononics and acoustic metamaterials and interdisciplinary engineering projects that cross into biomaterials and other areas.

Horst Hahn researches defects and diffusion in metals and ceramics, on nanostructured and amorphous materials, on tailored and tunable properties of nanostructures, on energy materials, printed electronics and recently, on high entropy materials.

Brian Kim's research interests include 2D quantum materials and heterostructures, experimental condensed matter and materials physics, light-matter interactions, nano-optics and plasmonics, nanoelectronics, quantum devices, NEMS, robotic nano-manufacturing, nanofabrication.

Minkyu Kim's research interests are broadly clustered in the areas of bioinspired/biomimetic materials, biomolecular engineering, soft condensed matter physics and nanoscale biophysics. His work target applications in biotechnology for improving healthcare and national defense. He has a joint appointment with the Biomedical Engineering Department.

Marat Latypov has a wide range of interests in the field of materials science including materials informatics, modeling and simulation, artificial intelligence, alloy design and materials process optimization. He is the author or co-author of 30 scholarly publications.

Douglas Loy is involved in polymer science. He focuses on the synthesis and processing of new materials for energy related applications, namely sol-gel science and materials, new materials and methods for advanced membranes, and environmentally responsive materials. He has a joint appointment with Chemistry.

Pierre Lucas researches infrared materials. He is an expert on the fundamentals and applications of infrared glasses including their structure, photosensitivity and the development of novel

optical sensors. He also researches molten salt for energy storage and transport. He is very active in international education and has led the development of an international dual Ph.D. degree between University of Arizona and University of Rennes and University of Lille in France, which allows students to alternate course and research work between the two institutions and earn a double Ph.D. degree.

Krishna Muralidharan is an expert in integrated computational materials science and engineering. He also conducts experiments in carbon nanoscience geared towards creating novel paradigms for optimizing energy utilization, storage and conversion systems.

Zafer Mutlu's research interests include design, synthesis, characterization, engineering, electronic device applications, and large-scale, system-level integration of nanoscale and quantum materials, including 0D molecular systems, 1D molecular wires, graphene nanoribbons (GNRs) and heterojunctions, and carbon nanotubes (CNTs), 2D layered materials and heterostructures, and other quantum materials.

B.G. Potter, associate department head, pursues research in optical, electronic and optoelectronic materials. His expertise encompasses synthesis and study of glass, ceramic, and molecular hybrid materials for photonic, electronic, and energy applications with recent activities addressing degradation effects in photovoltaic systems and graphene-based materials systems. He also heads the graduate studies committee.

Benoit Revil-Baudard research interests include Numerical Modeling of Materials and Forming Processes, Computational Plasticity, Modeling and Simulation of Energetic Systems, Dynamic Behavior of Materials, Damage and Fragmentation of Heterogeneous Systems, Material characterization, Anisotropic materials.

Sammy Tin research interests include Physical metallurgy and mechanical properties of high-performance structural materials, solidification and solid state forming of metals, development of innovative metals and alloys, additive manufacturing, integrated computational materials engineering and digital twinning of advanced manufacturing processes.

Donald Uhlmann is active in bio-polymers, glasses and traditional polymeric materials. His expertise lies in the areas of wet chemical synthesis of ceramics and polymer-ceramics hybrids. Particular emphasis is directed to materials with novel optical and mechanical properties, to novel antimicrobial agents based on chemically-synthesized nanoparticles with tailored surface chemistries, He also teaches from patents literature.

Andrew Wessman's research interests include physical metallurgy, mechanical behavior of materials and materials processing, high temperature alloys and aviation materials, additive manufacturing alloy and process design, modeling and simulation.

Xiaodong Yan's research focuses Semiconductor devices and physics, nanofabrication, 2D materials, neuromorphic computing, quantum computing. He is the author or co-author of more than 40 scholarly publications.

5. Admissions Information

Students may go to the following website to apply to the graduate programs in Materials Science and Engineering: https://apply.grad.arizona.edu/users/login

For detailed information on graduate admissions please go to:
https://grad.arizona.edu/admissions

MS and PHD applicants must provide the following information when applying to the MSE program:

1. Minimum GPA 3.0
2. Official transcripts
3. Letters of recommendation:
    a. PHD Applicants are required to submit 3 letters of recommendation
    b. M.S. Applicants are required to submit 2 letters of recommendation
    c. M.E. Applicants are required to submit 1 letter of recommendation
4. Statement of purpose
5. Resume

International applicants must also provide:

Minimum TOEFL (interned-based): 79
Minimum TOEFL (paper-based): 550
Minimum IELTS (overall band score): 7
GRE scores

6. Degree Requirements and Deadlines

It is important that students consult with the graduate program coordinator regarding the department's degree requirements and deadlines. Students should also become familiar with the Graduate College website which includes official degree requirements, procedures and deadlines. This information can be found at: http://catalog.arizona.edu/
https://grad.arizona.edu/gsas/degree-requirements

All MS and PHD students must submit GradPath forms to the Graduate College. The following websites provide important information on dates/deadlines, resources for parents, professional development, and health/wellness:

http://grad.arizona.edu/new-and-current-students
http://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines

7. Doctoral Degree Requirements

Admission to the Ph.D. Program. As a general policy, applicants with an M.S. degree in Materials Science and Engineering or an allied field that includes the completion of a thesis can be considered for the Ph.D. program. Applicants may also bypass the M.S. degree and apply directly to the Ph.D. program. In both cases, once admitted to the program, the student will not be elevated to Ph.D. candidacy (allowing his/her to pursue a doctoral degree within the Department) until successful completion of the MSE qualifying examination.

General Requirements. The Ph.D. program in The Department of Materials Science and Engineering includes the following required elements:

1. Satisfactory completion of the MSE qualifying examination (see below for description and specific requirements).

2. The selection of a Dissertation Committee. This Committee will be composed of a minimum of three members. The Research Advisor and two additional members. The Research Advisor must be tenured, or tenure-track with an appointment within the MSE Department. At least one of the additional members must have a ***primary*** appointment in MSE. The remaining additional members may be tenured or tenure-track with appointment within the University of Arizona. Pre-approval for a "special" member, i.e. one from outside the University of Arizona, can also be requested through the MSE Academic Programs office and the Graduate College. Typically external members are involved with the student's research topic and may represent perspectives and expertise unique to the interdisciplinary nature of the research effort. The Student and Research Advisor will work together to identify appropriate Dissertation Committee members.

3. The completion of at least 63 units of graduate work beyond the B.S. degree. To meet the minimum Graduate College residence requirement, the student must complete a minimum of 30 units of "in-residence" graduate credit at the University of Arizona, (18 units of dissertation plus 12 units of regular graded coursework taken at the University of Arizona). "In residence" units are those offered by the University of Arizona, either via conventional, on-campus classroom courses or through online course offerings. In addition to satisfying the "in-residence" requirement, the 63 graduate units must include:

    - **36 units of work in the major subject (MSE). These units must include:**

        a. **18** units of regularly scheduled classes that utilize an A,B,C-type grading scheme. This coursework shall include - **MSE 510 - Thermodynamics, MSE 572 - Kinetics, MSE 502 – Research Proposal and at least 9 units of 500 level courses in the Department**.

        b. **18** units of non-graded coursework (this may include research, independent study). Graded courses may also be used to satisfy this unit requirement.

c. Of these 18 non-graded units, the student must enroll in Colloquium, MSE 595a, during each Fall and Spring semester throughout their doctoral program of study. ***Only 2 units of seminar (MSE 595a) will count towards the non-graded unit requirement, however.*** In addition, each student at the Ph.D. level is required to make one colloquium presentation during the pursuit of this degree. (*Students who are unable to register for seminar in a given semester (s) may request enrollment exemptions by formally petitioning the MSE Graduate Studies Committee.)*

- **18 units of dissertation**

- **9 units in the Minor subject (see Ph.D Minor requirements below). *Please note that the number of credits for the minor depends on program, which is often more than 9 units.***

NOTE: In the event that the student has already received a M.S. in MSE at the University of Arizona or elsewhere, up to 30 units from a completed M.S. degree program may be credited toward the Ph.D. Specific distribution of these units amongst the required curriculum elements above will be determined in consultation with the MSE Academic Programs Office and the MSE Graduate Studies Committee. Units earned from a completed M.S. program from outside the University may also be considered for transfer via a petition for approval to the MSE Graduate Studies Committee. Identification of appropriate units for transfer and their application amongst the required curriculum elements will be determined in consultation with the MSE Academic Programs Office and the MSE Graduate Studies Committee. Students must first fill out an evaluation of transfer credit form via gradpath in order to determine transfer course eligibility. This form may be found at: https://grad.arizona.edu/forms/gsas

- **Plan of Study**: In conjunction with his/her major professor or advisor, each student is responsible for developing a Plan of Study during their first year in residence, to be filed with the Graduate College no later than the student's third semester in residence. The Plan of Study identifies (1) courses the student intends to transfer from other institutions (see above NOTE for additional information regarding transfer units); (2) courses already completed at the University of Arizona which the student intends to apply toward the graduate degree; and (3) additional course work to be completed in order to fulfill degree requirements. The Plan of Study must have the approval of the student's major professor and department head (or Director of Graduate Studies) before it is submitted to the Graduate College.

4. The satisfactory completion of all requirements associated with the minor program chosen by the student.

5. The satisfactory completion of the MSE Comprehensive Examination (see below for description and specific requirements).

6. The preparation of a dissertation detailing the research work performed that is accepted by both the student's Research Advisor as well as the faculty Dissertation Committee.

7. The satisfactory completion of the Final Dissertation Defense Examination. The date, time and location of final defense must be scheduled with the graduate college in advanced using the announcement of final oral defense form in Grad Path.

Qualifying Examination. The Qualifying Examination (QE) must be completed within the first three regular academic semesters (i.e. not including summer and winter sessions) after admission to the Ph.D. program. In the event that the student does not successfully complete this requirement, the student has the option to pursue a Masters degree (if one has not already been obtained) or to leave the program. Specifics of the QE format and schedule follow:

The QE is administered as a written examination comprised of two modules addressing the following material:

a. fundamental materials science concepts and principles (thermodynamics, kinetics, phase transformations, etc.).

b. the application of these fundamental principles to specific issues in materials processing, structure, and properties.

Each testing module will last a maximum of 3 hours. The qualifying examination will be administered as needed each semester by the MSE faculty.

In the event that a student fails the QE on the first attempt, another attempt may be made in the next academic semester. No further attempts, however, may be made in the event of a second failure.

QE content will be focused on a limited set of primary source materials (texts, notes) identified to the student by the Graduate Studies Committee within the semester immediately prior to that in which the student will take the QE.

Comprehensive Examination. The Comprehensive Examination is comprised of two parts: Both parts of the examination must be passed satisfactorily in order to pass the entire examination.

1. Written Examination

To serve as the written portion of the Preliminary Examination, graduate students will write and defend a formal research proposal. The research proposal development is done as part of MSE 502. Graduate students are encouraged to take this course in their second semester. During the course, students will formulate and submit an original research proposal and defend it.. The oral defense of the written proposal consists of a public presentation plus a private question session. The examining committee will consist of the course instructor, the candidate's advisor and a member of the faculty chosen by the candidate.

The proposal should:

a. define the basic problem to be solved;

b. explain the background and provide a thorough literature survey pertaining to the problem;

c. indicate the proposed method to be used in the course of the research to solve the problem, including the necessary theory and experimental techniques to be used.

The student has the responsibility for choosing a topic for a proposal in consultation with his/her advisor or any other faculty member to ensure that the problem lies within the capabilities of the Department. It also should fall within the realm of expertise of the faculty in order to ensure proper guidance. The proposal is not required to be on the student's chosen dissertation topic.

The proposal should clearly establish that the candidate is capable of independent, original, creative thinking. Students should also demonstrate their ability to integrate knowledge.

A student who demonstrates excellence (as represented by an A) in the course will achieve successful completion of the written portion of the comprehensive examination in MSE.

2. Oral Examination

When the written portions of the Comprehensive Examination (in the major and in the minor fields) have been completed satisfactorily and when the student is ready to take the Oral Examination, the Department will officially acknowledge successful completion of the written Comprehensive Examination requirements. The student will work with the MSE Academic Programs Office to notify the Graduate College and request a date for the Oral Examination. The oral portion of the examination must be taken within 6 months of departmental acknowledgement. The Oral Examination shall be taken no later than 3 months before completion of the dissertation and Final Dissertation Defense Examination. It should be taken as soon as the student has met all the requirements of the written portions covering the minor field. The Oral Examination will include a brief presentation reporting on progress on the dissertation topic. The presentation will be followed by a question period covering general MSE topics and concepts. ***The Oral Examination is not intended as an opportunity for questioning regarding student dissertation work.***

The members of the Oral Examination Committee will be chosen by the candidate. The examining committee must consist of a minimum of four members. The Major Advisor (must be a tenured or tenure-track faculty member with an appointment in MSE) and two additional members who must be tenured, or tenure-track with ***primary*** appointments in MSE. The fourth member may be tenured or tenure-track (with an appointment in the University of Arizona), or a special approved member. Special members must be pre-approved by the Dean of the Graduate College. Any members beyond the fourth can also be tenured or tenure-track, or special approved members.

Dissertation and Final Examination. The dissertation represents the culmination of the candidate's research. The candidate submits the dissertation to the Dissertation Committee (previously determined by the student and Dissertation Advisor; see Item 2 under General Requirements (above) for description and specific requirements), the document should be of a very high quality in which the need for further editing should be minimal. The Graduate College has a Dissertation/Thesis manual available in order to assist students with formatting their Dissertation or Thesis. Please refer to the following website:

http://grad.arizona.edu/gsas/dissertations-theses/dissertation-and-thesis-formatting-guides.

Some latitude is permitted for adherence to practices of technical journals in the candidate's field of interest. The student should consult with his/her advisor and dissertation committee for advice in these specific situations. The presentation is expected to be complete and to include all of the details necessary to make clear the basis used for the theoretical and experimental treatment of the problem. Full use of appendices should be made to support areas dealt with in a condensed manner in the text.

The candidate will submit the proposed dissertation to each member of his/her examining committee for preliminary acceptance and minor editing suggestions of the work. As submitted, however, the proposed dissertation is expected to be complete, in typed form and technically and grammatically correct.

The candidate will arrange a time schedule such that each member of the Dissertation Committee will have at least one week to review the proposed dissertation before the final examination unless otherwise required by the Dissertation Committee members.

The Final Examination will consist of a presentation by the candidate of his/her dissertation in a manner similar to that commonly used at technical meetings in the presentation of technical research papers. The presentation will be followed by a question period in which the Dissertation Committee may ask questions related to the dissertation and to general matters of the candidate's field of study.

The report of the Dissertation Committee will be sent to the Graduate College. If the candidate has passed, the report will be placed in the Graduate Student Academic Services office awaiting completion of the final copy of the dissertation. It is the student's responsibility to make corrections, additions, or deletions required by the Dissertation Committee. When the Committee approves the final copy, the student submits it to the Graduate College for its approval. The Graduate College will have final approval of the format of this final copy of the dissertation. Upon successful completion of the Final Dissertation Defense Examination, the candidate submits the dissertation electronically for forwarding to the Library of The University of Arizona and to University Microfilms, Inc (UMI).

Dissertation Copies. The student is responsible for paying for the preparation and copying of this dissertation. One bound copy must be provided to the major professor and one copy to the Department.

Ph.D. MINOR

Ph.D. students majoring in the MSE Department must choose a minor course of study. The minor may be pursued either within the MSE Department or in a different department within the University. The selection of the minor area will be done with the approval of the student's Dissertation Advisor in consideration of the student's goals. If taken within the Department, the minor shall consist of a minimum of 9 units of graduate credit courses listed in the Department.

Ph.D. candidates in other departments at the University of Arizona who wish to take a minor in the Department of Materials Science and Engineering will be required to take a minimum of 9 units of graduate credit courses listed in the MSE Department.

A minimum GPA of 3.5 is required within the 9 units to fulfill MSE minor requirements. This minimum GPA also satisfies the written portion of the minor examination.

Additional Information: For more information on policies, degree requirements including deadlines and forms, please go to the following website:

http://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy

For more information on time limitation for the doctoral program, please go to the following website:

https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#time-limitation

8. Master of Science Degree Requirements

Courses used to satisfy degree requirements must be approved as part of the student's Plan of Study (see Plan of Study description below).

Course Requirements:

- 18 units of regularly scheduled (A,B,C) graduate courses, including MSE 510-Thermodynamics, MSE 572 – Kinetics. A minimum of 9 units of the 18 required units must be 500 level MSE courses.

- 6 units of miscellaneous graduate courses (research, independent study or regularly scheduled graduate-level courses). Only 1 unit of seminar (MSE 595a) will count towards the total misc. coursework requirement. However***, the student must be enrolled in seminar each semester****.

- 6 units of thesis.

30 Units Total plus the thesis defense (see below).

Students may transfer up to six units of course work completed at other institutions accredited for graduate work. Correspondence courses will not be accepted for graduate credit. Compatibility of course credits for application within the MSE Master of Science curriculum will be determined by the Department (see Plan of Study requirements below).

Every graduate student is required to enroll in the Colloquium, MSE 595a, during Fall and Spring semesters. In addition, each student at the M.S. level is required to make one colloquium presentation during the pursuit of his/her degree.

Final Examination/Thesis Defense. All students accepted as candidates for a Master's degree with thesis option are required to pass an oral examination before a faculty of three committee members. The examination shall consist of questions of a fundamental nature, designed to probe the depth of understanding and knowledge in the student's thesis area. Students are advised to concentrate their study upon fundamentals and general principles. It is the student's responsibility to request this examination when all course work has been essentially completed, and a grade point average of 3.00 has been attained for all courses taken for graduate credit, and the completed thesis has been accepted and approved by the thesis advisor. Typed copies of the thesis must be provided to members of the examining committee. The time and place of the examination will be chosen in conjunction with the advisor.

The Master's Thesis. Research projects are typically defined by the source of sponsored research support (e.g. federal, state, and local agency grants, contracts with industrial partners and national laboratories). The student is urged to discuss potential research topics with several faculty members in order to identify project opportunities that are of interest and for which the Department/faculty member has the necessary equipment, supplies, and resources. When a thesis topic has been selected, the student, in conjunction with the faculty advisor sponsoring the research, shall select a faculty committee to oversee the research, and to advise the student during the research period.

> It should be kept in mind that an M.S. thesis, while not necessarily of the same length and depth as a Ph.D. dissertation, should be publishable in the technical literature and represent some extension of knowledge in the field.
>
> The student is responsible for the preparation and copying of the thesis. One copy of the final, approved thesis must be provided to the major advisor and one copy to the Department.

A student completing a master's thesis (with enrollment in course number 910) is required to **archive the thesis** upon final approval of the thesis committee. The thesis will be added to the University of Arizona Campus Repository and to the national archive of dissertations and theses maintained by ProQues/UMI. There is no charge to the student for archiving the thesis. The thesis must have been successfully defended and approved by the thesis committee with all final edits completed in time for the student to submit it online for archiving by the **graduation deadline** for the student's graduation term. For more information on thesis archiving please go to: https://arizona.app.box.com/v/grad-gsas-archvthesis

Time Limitation for Master of Science Degree. All requirements for the master's degree must be completed within 6 years to ensure currency of knowledge. Time-to-degree begins with the earliest course listed on the Plan of Study, including credits transferred from other institutions. Work more than 6 years old is not accepted toward degree requirements.
Students who take a break in their studies or whose time to degree exceeds 6 years should check with Elsa Morales in Mines Bldg. Rm. 131 to determine their options.

Master's Plan of Study

Each student is responsible for developing a Plan of Study as early as possible during the first few months in residence, to be submitted to the Graduate College no later than the second semester in residence.

All deficiencies must be satisfied before the Plan of Study is approved.

The Plan of Study identifies: (1) courses the student intends to transfer from other institutions; (2) courses already completed at The University of Arizona which the student intends to apply toward the graduate degree; and (3) additional course work to be completed to fulfill degree requirements. The Plan of Study must have the approval of the student's major professor and department head (or chair of the Graduate Committee) before it is submitted to the Graduate College.

Completion of Master's Requirements

This form is submitted by the department once student has completed all degree requirements. The department's Graduate Coordinator (Elsa Morales) will submit the Master's/Specialist Completion Confirmation form in GradPath on behalf of the student. The submission of the Completion Confirmation form starts the final audit of the student's program and ultimately leads to the award of the student's degree.

For more information on policies, degree requirements including deadlines and forms, please go to the following website:
http://grad.arizona.edu/gsas/degree-requirements/masters-degrees

**students who are unable to register for seminar in a given semester (s) may request enrollment exemptions.*

8.1 M.S. Non-Thesis Degree Requirements

The Non-Thesis M.S. is a terminal degree (in that students who receive this degree and wish to pursue a Ph.D. must reapply for admission into the MSE Graduate Program). Courses used to satisfy degree requirement must be approved as part of the student's Plan of Study (see Plan of Study description below).

Course Requirements:

- 27 units of regularly scheduled (A,B,C) graduate courses of which 15 units must be from the MSE department, including MSE 510 (Thermodynamics), MSE 572 – Kinetics.

- 3units of miscellaneous graduate (independent study or regularly scheduled graduate-level courses). Only 1 unit of seminar (MSE 595a) will count towards the total misc. coursework requirement. However, ***the student must be enrolled in seminar each semester****.

  NOTE: Research units ***cannot be counted*** toward the course unit requirements for the Master of Science degree with Non-thesis Option.

30 Units Total.

Students may transfer up to six units of course work completed at other institutions accredited for graduate work. Correspondence courses will not be accepted for graduate credit. Compatibility of course credits for application within the MSE Master of Science, non-thesis option curriculum will be determined by the Department (see Plan of Study requirements below).

Every graduate student is required to enroll in the Seminar, MSE 595a, both Fall and Spring semesters. In addition, each student at the MS. level is required to make one seminar presentation during the pursuit of his/her degree.

The cumulative grade point average required for graduation is 3.00, based upon courses taken towards the advanced degree. There is a limit of 6 years of total elapsed time from the point of admission to Graduate study to the completion of the M.S. degree requirements.

Master's Plan of Study

Each student is responsible for developing a Plan of Study as early as possible during the first few months in residence, to be submitted to the Graduate College no later than the second semester in residence.

All deficiencies must be satisfied before the Plan of Study is approved.

The Plan of Study identifies: (1) courses the student intends to transfer from other institutions; (2) courses already completed at The University of Arizona which the student intends to apply toward the graduate degree; and (3) additional course work to be completed to fulfill degree requirements. The Plan of Study must have the approval of the student's major professor and department head (or chair of the Graduate Committee) before it is submitted to the Graduate College.

Completion of Master's Requirements:

This form is submitted by the department once student has completed all degree requirements. The department's Graduate Coordinator (Elsa Morales) will submit the Master's/Specialist Completion Confirmation form in GradPath on behalf of the student. The submission of the Completion Confirmation form starts the final audit of the student's program and ultimately leads to the award of the student's degree.

For more information on policies, degree requirements including deadlines and forms, please go to the following website:
http://grad.arizona.edu/gsas/degree-requirements/masters-degrees

**students who are unable to register for seminar in a given semester (s) may request enrollment exemptions.*

8.2 Master of Engineering

The Master of Engineering degree is a cooperative program of three universities in Arizona: the University of Arizona (UA), Northern Arizona University (NAU), and Arizona State University (ASU). Students in this program enjoy an opportunity to select from a broad spectrum of courses and an exposure to a variety of faculty perspectives and research interests. Because this program is intended to meet the advanced technical educational needs of practicing engineers, courses are delivered through distance delivery formats – including web, web-streamed, and video. Of course, students with access to our campuses are welcome to take on-campus ("face-to-face") courses as well.

To apply, a student interested in the program is admitted to one of the three universities, which becomes their "home institution." Working with an academic advisor from the home institution, the student develops a program of study that satisfies the Master of Engineering degree requirements. This program can include courses from any of the three universities – it might include transfer credits from other universities as well. However, at least 10 credit hours must be completed from the home institution. The Master of Engineering degree program involves three separate universities, each with their own set of policies and guidelines. Because of that, some elements of the program details will vary from one home institution to another.
Admission to the program begins with the selection of your home institution and, upon admission to the program, the university that is designated as your home institution will be your source for academic advising, record-keeping and other student services, and ultimately confers your ME degree.

Students admitted to the Master of Engineering program are expected to have an appropriate academic background for their intended area of study. In general, this means a Bachelor of Science B.S. degree in an appropriate engineering area from an ABET accredited institution, with sufficient engineering and related coursework to begin taking graduate level engineering courses upon admission to the program. However, please note that in certain cases a student with

a B.S. in a related field may be admitted into the program on condition of completing a number of prerequisite courses. In addition, a minimum GPA (Grade Point Average) of 3.0 on a 4-point scale is required for admission to the program. This minimum GPA requirement can be based on the last 60 units of coursework leading to the bachelor's degree. International students must submit TOEFL scores (unless they hold a degree from a university in which English is the primary language of instruction).

Students meeting these minimum admissions requirements may be considered for admission to the program. Depending on the student's intended area of study and home institution, additional admission requirements (such as a higher GPA or a minimum GRE score) may be required. Students are encouraged to contact representatives of their anticipated home-institution to determine if any of these additional admissions requirements apply.

Master of Engineering in Innovation, Sustainability and Entrepreneurship

In an effort to address such Federal Government initiatives as the Materials Genome Initiative for Global Competitiveness and Computational Materials and Chemistry, as well as industry needs and the National Academy of Engineering's Grand Challenges for Engineering, the Department of Materials Science and Engineering is offering a new graduate program. The Master of Engineering with an option in Innovation, Sustainability and Entrepreneurship has been approved and is now an available degree through the College of Engineering. The program is geared toward students and industry professionals who are interested in the translation and transfer of technologically-promising research discoveries into sustainable technologies and processes. It offers a combination of business-oriented classes and engineering courses to help Engineers Bridge the gap between innovative ideas and sustainable economic development strategies. Degree requirements are outlined below.

Degree requirements for Materials for Sustainability & Innovation: 30 units of graduate coursework as follows:

12 units of coursework with a focus on business and management.

- ENTR/SIE 557 (3): Project Management (S)
- ENGR/SIE 514 (3): Law for Engineers/Scientists (S)
- ENGR/SIE 567 (3): Financial Modeling for Innovation (F)
- SIE 515 (3): Technical Sales & Marketing (F&S)

18 units of coursework covering advanced materials and cutting-edge developments in materials science and engineering.

12 units of required courses.

- MSE 596a (3): Special Topics: Materials for Innovation (S)
- MSE 550 (3) – Materials Selection for the Environment (S)
- MSE 570 (3)– Technology of Polymers and Ceramics (Fall)
- ENGR/MSE 502 (3): Research Proposal Preparation (S)

6 units of signature foundational course work.

- MSE 531a (3): Engineering Materials Fundamentals

- MSE 580 (3): Advanced Characterization Methods in Materials Science and Engineering

MSE electives (3 units required). Course options include the following list or can be chosen in consultation with advisor.
MSE 535 (3) – Corrosion and Degradation
MSE 540 (3) – Metal Additive Manufacturing

S = Spring, F = Fall

8.3 Accelerated Master's Program (AMP in MSE)

8.3.1 Overview

The AMP program in MSE is a program designed to enable UA undergraduate students to complete both the B.S. degree and the M.S. degree in MSE in a total of 5 years.

8.3.2 Application Process

Students apply in the junior year via the graduate college website. After acceptance to the AMP, in the senior year, student will enroll for both undergraduate and graduate courses. These will count as electives for the B.S and M.S degrees. The final year (5^{th} year), students will enroll for graduate coursework.

8.3.3 Admission Requirements

1. Completion of a minimum of 75 undergraduate credit hours will be required at the time of application; a minimum of 90 undergraduate credit hours will be required at the time of entry into the AMP. If the student's GPA falls below 3.30 at the time s/he has completed 90 units, the student will not be admitted into the program. Courses taken for audit may not be included in the total number of units counted for eligibility or admission.

2. Completion of at least 12 earned units of undergraduate course work in the major at the UA.

3. Units still graded Incomplete, units graded Pass/Fail or units taken as audit will not count toward the requirement of the 12 undergraduate units in the major.

4. Completion or near completion of general education requirements.

5. Submission of a graduate application and payment of a graduate application fee.

6. Demonstration of the maturity necessary for success in an accelerated, highly competitive program.

7. Expectation to complete the undergraduate degree within four years. The undergraduate degree requirements must be completed before the student is eligible to have the Master's degree awarded.

8.34 AMP Curriculum

Senior year curriculum requirements for BS in MSE is as follows:

SENIOR YEAR			
ENGR 498A CROSS DISCIPLINE DESIGN	3	ENGR 498B CROSS DISCIPLINE DESIGN	3
MSE TECH ELECTIVE** **(MSE 5XX)**	3 **(3)**	MSE TECH ELECTIVE** **(MSE 5XX)**	3 **(3)** 6 **(3)**
TECH ELECTIVE** **(ENGR 5XX or MSE 5XX)**	3 **(3)** 3	TECH ELECTIVE** **(MSE 5XX or ENGR 5XX)**	3
TECH ELECTIVE** Tier 2 INDV	3	Tier 2 ART/HUM*	
Total	15	Total	15

An MSE student would register for MSE 5XX or ENGR 5XX and fulfill the tech elective or MSE tech elective requirement and earn 12 graduate credits as an MSE senior.

For the remaining year the enrollment would look as follows:

FALL	**SPRING**
MSE 595a - Seminar(1)	**MSE 572 - Kinetics (3)**
MSE 510 - Thermodynamics(3)	**MSE 502 – Research Proposal (3)**
MSE 5XX or ENGR 5XX (3)	**MSE 595a – Seminar (1)**
MSE 5XX or ENGR 5XX (3)	**MSE 599 (non-graded) or MSE 5xx or ENGR 5xx (2)**
10 units	**8/9 units***

***NOTE:** although we require that each MS and PHD student register for seminar each semester, only 1 unit can count towards MS plan of study and 2 units towards PHD plan of study

MSE 5XX – Student must take at least 15 units in MSE for MS non-thesis

ENGR 5XX – students have the option of taking courses outside MSE (other engineering disciplines) or they can opt to take MSE classes.

9. MSE Graduate Course Listing

Course No.	Course Title
502	Research Proposal Preparation
503	Applied Surface Chemistry
504	Optical Spectroscopy of Materials
505A	Introduction to Archaeological Conservation
506	Plastic Behavior of Materials: Modeling and Engr Scale Appls
510	Thermodynamic Characterization of Materials
511	Mineral Processing
512	Physical Chemistry of Materials
513	Planetary Materials
515	Microelectronics Manufacturing and the Environment
524	Physics and Chemistry of Ceramic Materials
525	Sol-gel Science
526	Nanoscale Analysis of Materials Using TEM
527	Physics-informed machine learning and engineering applications
531	Sustainable Materials Design Lab
531A	Engineering Materials: Properties and Selection
534	Advanced Topics in Optical and Electronic Materials
535	Corrosion and Degradation
537	Surface Science
540	Metal Additive Manufacturing
546	Semiconductor Processing
547L	Semiconductor Processing Laboratory
550	Materials Selection for the Environment
551	Integrated Computational Materials Science and Engineering
554	Electronic Packaging Principles
555	Physical Metallurgy and Processing of Alloys

Course No.	Course Title
560	Materials Science of Polymers
561	Biological and Synthetic Materials
562	Materials Aspects of Composite Materials
564	New Materials for Healthcare
565	Microelectronic Packaging Materials
568	Heritage Conservation Science
570	Technology of Polymers and Ceramics
571	The Formation and Structure of Glass
571L	The Formation and Structure of Glass Lab
572	Kinetics Processes in Materials Science
574	Archaeometry: Scientific Methods in Art and Archaeology
580	Experimental Methods for Microstructural Analysis
588	Scanning Electron Microscopy
589	Transmission Electron Microscopy of Materials
595A	Materials
596A	Special Topics in Materials Science and Engineering
596S	Technology and Social Theory
599	Independent Study
693	Internship
697B	Applied Mathematics Laboratory
699	Independent Study
900	Research
909	Master's Report
910	Thesis
920	Dissertation

10. Expected Learning Outcomes for (Ph.D, M.S (thesis), M.S (non-thesis), M.E. (ISE)

Graduate program	Student Learning Outcomes
Ph.D.	1. demonstrate broad knowledge of MSE field and in-depth understanding of their doctoral research topic area 2. critically analyze published research results in MSE area of study 3. conduct original research utilizing modern engineering tools and techniques used in the profession on a significant materials topic 4. effectively communicate (through published works and oral presentation) and defend results of research to peers and broader scientific audiences
M.S. (thesis)	1. demonstrates understanding of MSE thesis topic area and its relationship to broader MSE field. 2. critically analyze published research results in his/her area of study 3. conduct original research utilizing modern engineering tools and techniques used in the profession on a significant materials topic 4. effectively communicate and defend results of research to peers and broader scientific audiences
M.S. (non-thesis)	1. demonstrates knowledge in an MSE topic area 2. demonstrates understanding of relationship to broader MSE field through program electives. 3. demonstrates an ability to prepare and deliver a technical talk
M.E. (ISE)	1. demonstrates knowledge in an MSE topic area 2. demonstrates understanding MSE technical principles in the context of business management or technology development issues through program electives. 3. demonstrates an ability to prepare and deliver a technical talk

11. Selection of a Research Project and Advisor

New graduate students should contact the graduate program coordinator, Elsa Morales to discuss the selection of a research project and advisor. Students are also encouraged to contact MSE faculty who match their research interests. Selection of a research project and faculty advisor should be completed within the first weeks upon arriving to the University of Arizona. Students who are self-supported or students with fellowship support should meet with all MSE faculty members who have research projects available.

12. Continuous Enrollment

The Graduate College Continuous Enrollment Policy can be found on the: http://grad.arizona.edu/policies/enrollment-policies/continuous-enrollment .

If students fail to obtain a Leave of Absence or maintain continuous enrollment, he or she will be required to apply for re-admission.

All international students are required to maintain full time status while studying in the US. To avoid violating current visa requirements international students should consult with the Office of Global Initiatives regarding enrollment requirements. Information can be found at:

http://global.arizona.edu/international-students/maintaining-status

and

http://global.arizona.edu/international-students/summer-enrollment.

13. Transfer Credit

Students who wish to transfer credit must submit a Transfer Credit form in GradPath before the end of their first year of study. The evaluation of transfer credit form can be found at:

https://grad.arizona.edu/forms/gsas

Course approvals for transfer credit must be approved by the graduate studies committee in order to be used towards MS or PHD plan of study.

All required units of credit must be at the **500-level** or above at The University of Arizona (or, in the case of transfer units, their equivalent at other institutions). A minimum of 12 units of regular grades taken at the University of Arizona are required to establish a University of Arizona GPA.

14. Satisfactory Academic Progress and standard time to degree

- Graduate students must maintain a grade point average of no less than a 3.0 in all graduate coursework. Student GPA is calculated at the end of each semester.
- MSE graduate Students are expected to enroll in and attend MSE 595a – Colloquium each semester. *Please note that students who are unable to register for seminar in a given semester (s) may request enrollment exemptions by formally petitioning the MSE Graduate Studies Committee.*
- MS and PHD students must complete MSE 510- thermodynamics and MSE 572 – Kinetics within their first year enrolled in the program. Additionally, PHD students must enroll for MSE 502 in the second semester of their program of study. Achieving an A-grade for this course will satisfy the written portion of the comprehensive exam.
- MSE qualifying examination (PHD students) must be taken in the 3rd semester.

- Successful completion of both written and oral portions of a comprehensive examination must be taken within four years of starting the Ph.D. program.
- Satisfactory progress must be made toward completion of the dissertation. If a student has not successfully defended the dissertation within three years of passing the comprehensive exam she or he can be deemed as not making satisfactory progress.
- General graduate student concerns should be discussed with the Graduate Studies Committee.
- New and continuing graduate students are expected to meet with their major professor to discuss their research and academic progress.
- All MSE thesis and dissertations must be formatted and submitted to the UA graduate College for archiving as part of the degree completion process. Students must also submit a bound copy of thesis/dissertation to the department as part of graduation requirements.

For more information on satisfactory progress please go to the following website:

https://grad.arizona.edu/policies/academic-policies/satisfactory-academic-progress

15. Remediation

If, during the annual evaluation of student academic performance (see item 18 below), a student is deemed to be making unsatisfactory progress in the program, the student may be subject to removal of any funding support provided by the MSE department and/or removal from the program. Students who are having academic deficiencies (e.g. earning poor grades, or not satisfying program requirements) will receive a written notice from the Graduate Studies Committee (MSE GSC) with specific suggestions as to how these academic issues might be remedied and the date by which such actions must be taken. This notification will also be send to the Graduate College and the student's graduate advisor.

The Graduate College has established guidelines, which departments must follow in order to dismiss graduate students from their programs. Students should familiarize themselves with the steps in this process so that they know their rights, responsibilities, and options for remedy should such a situation develop. Students who fail to attend to remediation requirements imposed by the department, MSE GSC, or Graduate College by the deadlines specified may be dismissed from the program.

16. Incomplete Grades

Students earning a grade of Incomplete, "I" for a course should submit a completed Report of Incomplete Grade form to the MSE Graduate Advisor for inclusion in their academic record. http://registrar.arizona.edu/gradepolicy/incomplete.htm . Incomplete grades should be completed in a timely manner and are submitted at the discretion of the course Instructor.

17. Student Appeal Policies

Students have the right to request exceptions to department policies and procedures by submitting a petition to the graduate studies committee. Petitions must be emailed to Elsa Morales, Program Coordinator, Sr. (elsam@email.arizona.edu) for initial review. Students should also go to the following website for more information on academic grievance procedures:

http://grad.arizona.edu/policies/academic-policies/summary-grievance-types-and-responsible-parties

18. Annual Evaluation

MSE graduate students are subject to an annual evaluation of their progress towards completion of degree requirements. The MSE Graduate Studies committee as well as the student's advisor is responsible for meeting with students at least once a year to review their progress towards degree.

19. Departmental Governance

The MSE Graduate Program is administered by the Graduate Studies Committee which is overseen by the Department Head. The graduate studies committee includes four faculty members and the Program Coordinator. The Graduate Studies Committee formulates policies and procedures for the operation of the graduate program in such areas as admissions, curricula, student supervision, and completion of degree program requirements.

20. Funding Opportunities

Students who are enrolled in the program may receive financial support in the form of fellowships, teaching assistantships or research assistantships. In order to receive financial assistance, students are required to be enrolled as full-time graduate students with at least 9 units registered each semester and must maintain a cumulative GPA of 3.0 or above. Students should recognize that financial support is not guaranteed. All students are encouraged to seek funding opportunities from various sources. The graduate college has online resources which may facilitate this: http://grad.arizona.edu/new-and-current-students

International students should note that additional requirements for financial aid eligibility apply.

Please see the following website for more information:

https://grad.arizona.edu/funding/ga/english-speaking-proficiency-evaluation

Graduate students may also apply for funding opportunities through the graduate college. More information regarding these opportunities can be found at:

https://grad.arizona.edu/funding

Additionally, graduate students who wish to be considered for funding in the form of Graduate College Fellowships must also show a level of financial need before funds can be released. Students should fill out the FAFSA form to demonstrate a level of need:

Domestic Students must file the Free Application for Federal Student Aid (FAFSA, www.fafsa.ed.gov) before funds can be disbursed.

International Students must submit the Financial Need Calculation for International Students form

21. University Policies and Information

Students are responsible for being familiar with the policies pertaining to graduate college policies, academic conduct, conduct of research and general student conduct from the websites below:

a. Graduate College http://grad.arizona.edu/
b. Information for parents:
   Child Care Subsidies and Family Friendly Information
   The Graduate College is dedicated to promoting and strengthening family relationships. Many resources have been designed to help graduate students balance and manage family, work, and school.
   - Graduate Assistant/Associate Parental Leave
   - Temporary Alternative Duty Assignments (TADA) for Teaching Assistants/Associates
   - Extension of Time to Degree Policy
   - Child Care and Parent Resources)
c. For professional development, for health and wellness, etc: http://grad.arizona.edu/new-and-current-students
d. General catalog: http://catalog.arizona.edu
e. Academic integrity: http://deanofstudents.arizona.edu/codeofacademicintegrity
f. Responsible Conduct of Research: http://www.orcr.arizona.edu