Mechanical and Aerospace Engineering Graduate Program

Graduate Student Handbook

Academic Year 2018-2019

Mechanical and Aerospace Engineering Graduate Program
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The Mechanical and Aerospace Engineering Program Options

- Master of Science (MS)—non-thesis
- Master of Science (MS)—thesis option
- Masters in Passing (MIP)
- Doctor of Philosophy (PhD)

All of the programs stress a sound foundation in technical fundamentals, communication and professionalism. The MS degree programs prepare engineers for doctoral study or industrial positions that specialize in research, project management and product innovation. The doctoral programs emphasize original research and provide students with a strong background for employment by academic institutions, government laboratories and industrial research laboratories. SEMTE offers a broad-based curriculum in design, system dynamics and control; fluid mechanics science and engineering; mechanics and dynamics of solids and structures; and transport phenomena, thermodynamics, and energy. Modern computational and laboratory facilities are available to support timely research investigations. The following sections provide information about program requirements, policies, and curricula.

Graduate Courses

Graduate course offerings in the School cover the classical areas, including aerodynamics and fluid mechanics, design and manufacturing, heat transfer and thermodynamics, solid mechanics and dynamics, and system dynamics and control as well as interdisciplinary topics. A list of current course offerings in these areas is given in Appendix A.

Graduate College Policies

The Graduate College has final approval of all plans of study and is responsible for the conferral of all graduate degrees. Students are thus responsible for reading, understanding, and abiding by all of the policies found in the Graduate College Handbook: https://graduate.asu.edu/sites/default/files/asu-graduate-policies-and-procedures%281%29.pdf as well as all SEMTE policies as described herein

Plan of Study

Students are able to submit a Plan of Study from the first day of their graduate studies. The Plan of Study (iPOS) is an interactive web based form that graduate students complete and which outlines all coursework required to obtain their degree. Master’s students are expected to complete the iPOS in their first semester and no later than their second semester. Doctoral students should file the iPOS no later than their second semester.

All SEMTE graduate students are required to submit and have their Plan of Study (iPOS) approved prior to being eligible for registration of their third semester classes. Thus students are expected to use of their first semester in the program to know faculty, selecting a faculty advisor, and creating their Plan of Study to demonstrate their intended path to graduate from
the program. The faculty chair must approve the iPOS. It is the student’s responsibility to ensure that the transcript and the iPOS are synchronized through a course change, to obtain the program faculty chair’s approval of any changes, and to submit all documentation to the SEMTE Graduate Academic Advising Office.

Audited courses do not apply toward the degree program and cannot be listed on the iPOS. In general SEMTE graduate students are not granted permission to audit a course until the student has filed a Plan of Study (iPOS) and has completed all coursework on the iPOS. Special requests to audit courses must be submitted to the Graduate Program Chair after approval by the faculty chair.

**Program Policy on Maximum Course Load**

Per the Graduate College, registration in nine credits is considered a full-time load for graduate students. Students who are a part of the Ira A. Fulton Schools for Engineering are restricted to a maximum of 11 credits per semester. Exceptions to register for more than 11 credits require the approval of both program committee chair and Graduate Program chair.

**Graduate Student Advising**

The initial advising of all incoming students is carried out by the SEMTE Graduate Academic Advising Office and the Graduate Program Chair unless a faculty advisor has been arranged prior to the student’s (PhD or MS with thesis) arrival to ASU. Throughout the student’s graduate program, the SEMTE Graduate Academic Advising Office can assist with the process towards completing the degree (i.e. registration, iPOS questions), but not with academic content. Questions involving academic content should be directed to either the faculty chair or the Graduate Program Chair.

**Professionalism and Honor Code**

Ethics and professional conduct are cornerstones of the Engineering profession and graduate students are fully expected to adhere to these expectations. Ethical violations (e.g. “cheating”) and unprofessional conduct with regards to faculty and staff will not be tolerated. ASU has approved an Honor Code to which the students have to adhere.

**Master of Science (MS)—non-thesis option**

The MS—non-thesis degree is the default master’s degree in Aerospace Engineering and Mechanical Engineering and two tracks are available:

- MS—non-thesis/portfolio
- MS—non-thesis/supervised project

The degree requires completion of 30 credit hours and consists of the following:

- At least fifteen (15) credit hours of graduate MAE coursework (500 level and above). Graduate non-MAE courses may be substituted, upon approval by the MAE Graduate Program Chair.
• At least six (6) credit hours of graduate mathematics-oriented courses (500 level and above). Students often take MAE 501 Linear Algebra in Engineering and MAE 502 Partial Differential Equations in Engineering but many other courses are acceptable, see list in Appendix A. Note that any MAE courses, such as MAE 501 and MAE 502, that are counted as mathematics-oriented courses cannot be “double-counted” towards the fifteen (15) credit hours of graduate MAE coursework.

• At least nine (9) credit hours of additional graduate courses; these may be either MAE or non-MAE courses, and are not restricted to science, mathematics, or engineering. All non-MAE courses must be pre-approved in order to count on the plan of study. Please discuss any non-MAE courses with your academic advisor prior to enrolling into the course. A maximum of three (3) credit hours of MAE 584 Internship may be counted towards this requirement. A combined maximum of six (6) credit hours of MAE 591 Seminar, MAE 594 Graduate Research Conference, or MAE colloquium classes may be counted towards this requirement.

For students carrying out a supervised project, the credit hours of MAE 598 Supervised Project can count towards this requirement and at least 3 credit hours of it must appear on their iPOS. A typical supervised project is expected to count for 3 hours. Requests for 6 hours of supervised project are allowed but must be approved in advance by the Graduate Program Chair. MAE 598 Supervised Project is normally taken during the final semester of study.

• International students in SEMTE programs are ineligible for Curricular Practical Training (CPT)

• A minimum cumulative grade point average of 3.00 is required on both transcript and iPOS.

Supervised Project

The supervised project is carried out under the supervision of a faculty member, typically a member of the MAE graduate faculty https://graduate.asu.edu/graduate_faculty although other ASU faculty members may be selected upon approval by the Graduate Program Chair. Students desiring to conduct a supervised project must first obtain the approval of a faculty member to work with them on the project. They must then request the approval of the Graduate Program Chair. At completion of the supervised project, the students must prepare a written report delivered to the faculty advisor of the project and deliver a short oral presentation to him/her. Credit is earned when the faculty advisor approves the written report and oral presentation.

For students carrying out a supervised project, the faculty chair is the faculty advisor for the project. The supervised project committee consists only of the faculty chair.

Portfolio

The Portfolio is a sample of the significant projects that a graduate student has carried out during his/her graduate studies showcasing the quality of the graduate education he/she has received. Students choosing the MS portfolio option must select two significant projects from
previously completed graduate MAE or Math coursework listed on their approved iPOS. The portfolio is then the concentration of the reports (presentation slides are acceptable if no report was submitted for that project) submitted to the instructors of the two selected graduate classes. A cover page needs to be included describing what courses the projects were carried out in, and why they were selected for inclusion in the Portfolio by the student. The Graduate Program Chair will be solely responsible for judging the quality of the portfolio and determining if it is satisfactory to serve as the required culminating event for the MS—non-thesis degree. For students selecting the portfolio option, the committee consists only of the Graduate Program Chair serving as faculty chair.

**Timeline**

i) File Plan of Study – prior to beginning of second semester of study (Spring or Fall only, not counting summer).

ii) Select “portfolio” for both the portfolio and supervised project options described above. If following the supervised project option, the student must first identify a faculty member to supervise the project, see above.

iii) Apply for graduation – please see the Academic Calendar for deadlines at: http://students.asu.edu/academic-calendar

iv) For students carrying out a supervised project, they must complete the SEMTE Graduate Advising - Academic Event Request Form 15 working days prior to the expected project presentation date.

v) Before the start of final exams on the last semester, present the results of the supervised project to the faculty advisor or submit the portfolio to the Graduate Program Chair, depending on the non-thesis option selected.

vi) Commencement date – See academic calendar

**Master of Science (MS)—thesis option**

The MS—thesis option is the School’s research master’s degree. A member of the ME or AE Graduate Faculty (with co-chair or chair status as specified on the web site) must agree to serve as the program committee chair (faculty advisor) for a student to be transferred to the MS—thesis degree program. The SEMTE Graduate Academic Advising Office will need to have confirmation in writing (email is acceptable) from the faculty member agreeing to serve as the thesis chair prior to a plan change being made to move to the MS—thesis degree.

The program committee chair, in consultation with the student, will establish a Program Committee. It shall be composed of a minimum of three members from the ASU faculty with at least two being from the ME or AE Faculty. If the committee chair has co-chair status on the graduate faculty, the program committee must include a MAE faculty member with chair or co-chair status serving as second co-chair.

Participation of individuals from institutions external to ASU is encouraged but must be approved by the Graduate Program Chair and the Graduate College.
The 30 credit hours consist of the following:

- At least twelve (12) credit hours of graduate MAE coursework (500 level and above). Graduate non-MAE courses may be substituted, upon approval by the MAE Graduate Program Chair.

- At least six (6) credit hours of graduate mathematics-oriented courses (500 level and above). Students often take MAE 501 Linear Algebra in Engineering and MAE 502 Partial Differential Equations in Engineering but many other courses are acceptable, see list in Appendix A. Note that any MAE courses, such as MAE 501 and MAE 502, that are counted as mathematics-oriented courses cannot be “double-counted” towards the twelve (12) credit hours of graduate MAE coursework.

- At least six (6) credit hours of additional graduate courses; these may be either MAE or non-MAE courses, and are not restricted to science, mathematics, or engineering. All non-MAE courses must be pre-approved in order to count on the plan of study. Please discuss any non-MAE courses with your academic advisor prior to enrolling into the course. A maximum of three (3) credit hours of MAE 584 Internship may be counted towards this requirement. A combined maximum of six (6) credit hours of MAE 591 Seminar, MAE 594 Graduate Research Conference, or MAE colloquium classes may be counted towards this requirement.

- Six (6) hours of MAE 599 Thesis is required. A final public defense of the thesis will be administered by the committee.

- A minimum cumulative grade point average of 3.00 is required on both transcript and iPOS.

**Timeline**

i) Identify a thesis advisor from the ME or AE Graduate Faculty. This should be done as soon as possible, but no later than the second semester of study.

ii) File Plan of Study – prior to beginning of second semester of study (Spring or Fall only, not counting the summer).

    vii) Apply for graduation – please see the Academic Calendar for deadlines at: [http://students.asu.edu/academic-calendar](http://students.asu.edu/academic-calendar)

iii) Complete the SEMTE Graduate Advising - Academic Event Request Form 15 working days prior to the defense to reserve a room.

iv) Schedule the defense with the Graduate College through the MyASU portal a minimum of ten business days (not including holidays) before defense date (consult 10-day calendar).

v) Submit thesis for format approval – please see the Graduate College deadlines and procedures for additional information: [http://graduate.asu.edu/graddeadlines.html](http://graduate.asu.edu/graddeadlines.html)

vi) Submit thesis title, date/time/location of defense, and abstract to the SEMTE Graduate Academic Advising Office for internal posting.

vii) Hold oral defense of thesis – must be completed by the last day to defend a thesis date as defined in [http://graduate.asu.edu/graddeadlines.html](http://graduate.asu.edu/graddeadlines.html)

viii) Submit pass/fail form to the Graduate College and a copy to the SEMTE Graduate Academic Advising Office.

ix) Submit thesis to ProQuest electronically when directed by the Graduate College.

x) Email the SEMTE Graduate Advising Office a copy of your Proquest submission receipt in order for any outstanding “Z” grades to be changed to “V”.

xi) Commencement date – See [academic calendar](http://students.asu.edu/academic-calendar).
Doctor of Philosophy (PhD) Program

The Doctor of Philosophy (PhD) degree is directed toward original research. The student is required to write and defend a dissertation that describes an original contribution within the chosen discipline. The research results should be suitable for publication in a reputable, scholarly journal. The School currently offers majors in Aerospace Engineering and Mechanical Engineering. PhD students must pass a Qualifying Exam, a Comprehensive Exam, successfully present their Dissertation Prospectus, and successfully defend their Dissertation, as described below.

Selection of a PhD Faculty Advisor

The student must select a faculty advisor (with co-chair or chair status as specified on the web site) who agrees to serve and will become the “faculty chair”. This process must be completed prior to the student enrolling for the third semester. The faculty chair’s name must be filed with the SEMTE Graduate Academic Advising Office through the filing of the Plan of Study (iPOS) on the MyASU portal. A change of faculty chair requires approval of the MAE Graduate Program Chair.

PhD Program Committee

University regulations note the possibility of having two separate supervisory committees—A Program Committee and a Dissertation Committee. In the MAE programs these will normally be one and the same and will be designated as the Program Committee (PC).

The faculty chair, in consultation with the student, will establish a PC, the purposes of which are to:

1) Approve the plan of study (iPOS)
2) Provide guidance for the student's research
3) Administer the qualifying and comprehensive examinations
4) Administer the dissertation defense

The PC shall consist of at least five ASU faculty members with the majority being from the MAE Faculty, but at least one being from outside the MAE. If the committee chair has chair status as Graduate Faculty, the remaining members must have at least member status or be approved by the Graduate Program Chair and Graduate College. If the committee chair has co-chair status, the program committee must include a MAE faculty member with chair or co-chair status serving as second co-chair. The remaining members must have at least member status or be approved by the Graduate Program Chair and Graduate College.
Participation of individuals from institutions external to ASU is encouraged but they must be approved by the Graduate Program Chair and the Graduate College.

**PhD Plan of Study (iPOS)**

The student in consultation with his/her PC chair and the PC must file an iPOS prior to enrolling for the second semester. The iPOS must meet general University requirements including the need for rigorous fundamental knowledge of engineering principles. Candidates for the PhD degree must complete a minimum of 84 semester hours of course and dissertation work distributed below. Thirty (30) credit hours of appropriate coursework from a previously earned master’s degree may be applied toward the total credit hours; at least fifty-four (54) hours must be taken at Arizona State University. A minimum cumulative grade point average of 3.25 is required on both transcript and iPOS.

The 84 credit hours consist of the following:

- At least twelve (12) credit hours of graduate MAE coursework (500 level and above) must be taken at ASU. These 12 credit hours may not include MAE 584 *Internship, MAE 590 Reading and Conference, MAE 591 Seminar* but rather must be regular graduate-level MAE courses.
- MAE 584 *Internship, MAE 591 Seminar, and MAE 792 Research* may be applied toward the 84 total hours, although not towards the major, minor, and math requirements.
- Twelve (12) hours of MAE 799 *Dissertation* must be taken and applied towards the 84 credit hour requirement.
- At least eighteen (18) credit hours of coursework directly related to the research area referred to here as the major
- At least nine (9) credit hours of coursework outside the major research area; these are restricted to mathematics, engineering and/or science unless approved by the Graduate Program Chair and are referred to here as the minor.
- At least nine (9) credit hours of mathematics-oriented coursework. Students often take MAE 501 *Linear Algebra in Engineering* and MAE 502 *Partial Differential Equations in Engineering* towards these requirements but many other courses are acceptable, see list in Appendix A. Note that any MAE courses, such as MAE 501 and MAE 502, that are counted as mathematics-oriented courses cannot be “double-counted” towards the other required MAE coursework.
- A maximum of two 400-level (undergraduate) courses (6 credit hours) may be taken towards the major, minor, or math requirements. These 400-level courses must be non-MAE courses.

**Note:** The faculty chair must approve the iPOS
PhD Qualifying Exam

A graduate student pursuing a PhD program of study in Aerospace or Mechanical Engineering must pass a qualifying exam, as described below:

- Oral examination carried out by the program committee on basic subject matter relevant to the student’s research, as defined by the program committee
- The student will not make a presentation, but rather will answer questions from the qualifying committee.
- The student is responsible for scheduling the qualifying exam in consultation with the program committee
- The qualifying exam must be taken and passed within 18 months of starting the PhD degree for students entering with a Master’s degree, and within 36 months of starting the PhD degree for students entering with only a Bachelor’s degree.
- Student will have one opportunity to retake the qualifying exam, in the event of failure. The attempt to re-take the exam must be completed within 24 months of starting the PhD degree, for students entering with a Master’s degree, and within 42 months of starting the PhD degree, for students entering with only a Bachelor’s degree.

PhD Comprehensive Examination and Dissertation Proposal Prospectus

All students intending to earn the PhD degree are required to pass a comprehensive examination. The examination will be administered by the PC. The student must prepare a written dissertation prospectus describing in details the research carried out by him/her up to that point and the research plan to be followed until completion of the dissertation. It must be submitted to the PC well enough in advance of the examination to allow the program committee to read it in details. The prospectus is considered as the written component of the comprehensive exam.

During the examination, the student will orally defend the prospectus to the PC and answer questions related to it. This is considered both as the oral component of the comprehensive exam and as the doctoral dissertation prospectus defense. It is the student’s responsibility to bring the required form (Report of Doctoral Comprehensive Exams/Dissertation Proposal Prospectus) to the defense and then to the SEMTE Graduate Academic Advising Office for School processing.

The comprehensive examination is taken after completing the PhD qualifying exam. The comprehensive exam must be taken within 12 months after passing the qualifying exam. Part-time students should apprise the Graduate Program Chair of a timely schedule for exam completion. Students who do not take the comprehensive exam by this deadline will be considered as not making satisfactory academic progress and may be recommended for removal from the program.

Masters in Passing (MIP)

Students who are enrolled in the Mechanical or Aerospace Engineering PhD program and
who do not have a previously earned MS degree may apply for a Masters in Passing (MIP)
on completion of 30 hours of appropriate graduate coursework and successful passing of
the comprehensive exam. The MIP requires a separate iPOS from the PhD and all grades
must be entered before the MIP can be awarded. Contact the SEMTE Graduate Academic
Advising Office for additional information.

PhD Candidacy

PhD students achieve candidacy status in a letter from the Graduate College Dean upon
passing the comprehensive examination and successfully defending the dissertation
prospectus with an approved iPOS on file. This is sent directly from the Graduate College and
is found in the MyASU system.

PhD Dissertation Defense

The dissertation defense is an oral and public examination administered by the PC in
accordance with Graduate College guidelines. The purpose of the examination is to evaluate
the student’s research efforts and written presentation (dissertation), and to determine if
the candidate is worthy of receiving a PhD degree. The emphasis of this examination is on
the student’s research as detailed in the dissertation and the general areas of study related
to it. The final dissertation defense must be taken within five years of passing the
comprehensive examination. It is the student’s responsibility to adhere to and be familiar
with the deadlines set forth by the Graduate College regarding defenses. Students must be
registered in at least one credit hour at the time of their defense.

Graduate Student Advising

For initial advising, incoming PhD students will report to the Graduate Program Chair who
may arrange for a temporary advisor based on the student’s stated area of interest. The
initial faculty advisor should be considered temporary until such time as a permanent faculty
chair is selected.
Graduate Course Offerings

Listed below are the graduate course offerings in a given research area. A full description of the courses is provided in the ASU catalog. Course selection must be determined in consultation with the PC chair.

a. Design, Systems and Control:

MAE 506 Advanced System Modeling, Dynamics and Control
MAE 507 Fundamentals of Control and Optimization
MAE 508 Digital Control: Design and Implementation
MAE 527 Finite Elements for Engineers
MAE 540 Advanced Product Design Methodology
MAE 541 CAD Tools for Engineers
MAE 542 Design Geometry & Kinematics
MAE 544 Mechanical Design and Failure Prevention
MAE 546 Advanced CAE Simulation
MAE 547 Mechanical Design and Control of Robots MAE
598 Multi-Robot Systems
MAE 598 Guidance and Navigation

b. Fluid Mechanics Science and Engineering:

MAE 504 Experimental Methods in Thermal and Fluid Processes
MAE 527 Finite Elements for Engineers
MAE 529 Continuum Mechanics
MAE 536 Combustion
MAE 561 Computational Fluid Dynamics
MAE 564 Advanced Aerodynamics MAE
566 Rotary-Wing Aerodynamics MAE
571 Fluid Mechanics
MAE 573 Advanced Fluid Mechanics
MAE 574 Multiphase Flows
MAE 575 Turbulence
MAE 577 Advanced Turbulence
MAE 578 Geophysical and Environmental Fluid Dynamics
MAE 598 Climate and Environmental Prediction
MAE 598 Advanced Computational Fluid Dynamics - Interfaces
MAE 598 Spectral Methods in Computational Fluid Dynamics
MAE 598 High Speed Computing
MAE 598 Applied Computational Fluid Dynamics

c. Mechanics and Dynamics of Solids:

MAE 510 Dynamics and Vibrations
MAE 512 Random Vibrations
MAE 513 Polymers and Composites
MAE 515 Structural Dynamics
MAE 520 Stress Analysis
MAE 521 Structural Optimization
MAE 523 Fracture Mechanics MAE
524 Theory of Elasticity
MAE 525 Mechanics of Smart Materials and Structures
MAE 527 Finite Elements for Engineers
MAE 529 Continuum Mechanics
MAE 557 Mechanics of Composite Materials
MAE 598 High Speed Computing
MAE 598 Vibration Analysis (MAE 514 from Spring 2017 onward)
MAE 598 Advanced Computational Mechanics
MAE 598 Structural Materials in Nuclear Power Systems
MAE 598 Plasticity
MAE 598 Mechanics of Micro/Nano Systems
MAE 598 Probabilistic Methods for Engineering Analysis and Design
MAE 598 Dynamic Behavior of Materials
MAE 598 Design of Aerospace Structures (MAE 526 from Spring 2017 onward)
MAE 598 Finite Elements in Engineering

d. Transport Phenomena, Thermodynamics and Energy:

MAE 504 Experimental Methods in Thermal and Fluid Processes
MAE 527 Finite Elements for Engineers
MAE 536 Combustion
MAE 561 Computational Fluid Dynamics
MAE 570 Thermodynamics
MAE 581 Advanced Thermodynamics
MAE 585 Solar Thermal Engineering
MAE 586 Advanced Heat Transfer MAE
587 Radiation Heat Transfer MAE 589
Heat Transfer
MAE 598 Wind Energy (MAE 579 from Spring 2017 onward)
MAE 598 Energy Systems Engineering
MAE 598 Renewable Energy Engineering (MAE 582 Renewable Energy - Mechanical Systems from Spring 2017 onward)
MAE 598 Renewable Power Plant Design
MAE 598 Rocket Propulsion
MAE 598 Internal Combustion Engines
MAE 598 Nanoscale Heat Transfer
MAE 598 Aircraft Propulsion (MAE 563 from Spring 2017 onward)

e. Mathematics Electives:

MAE 501 Linear Algebra in Engineering
MAE 502 Partial Differential Equations in Engineering
MAE 505 Perturbation Methods
MAE 512 Random Vibrations
MAE 521 Structural Optimization
MAE 542 Design Geometry and Kinematics
MAE 598 Advanced Computational Fluid Dynamics (offered Fall 2013 and prior)
MAE 598 Advanced CFD-Spectral Methods (first offered Fall 2014)/Spectral Methods in Computational Fluid Dynamics
MAE 598 Advanced Computational Mechanics (approved as of Spring 14)
MAE 598 Design Optimization
MAE 598 LMI Methods in Optimal and Robust Control
MAT 500 level or above courses
APM 500 level or above courses (not APM 525 High Performance Computing)
STP 500 level or above courses
EEE 550 Transform Theory and Applications
EEE 554 Random Signal Theory
CSE 577 Advanced Geometric Modeling
AML 591 Modeling with Game Theory