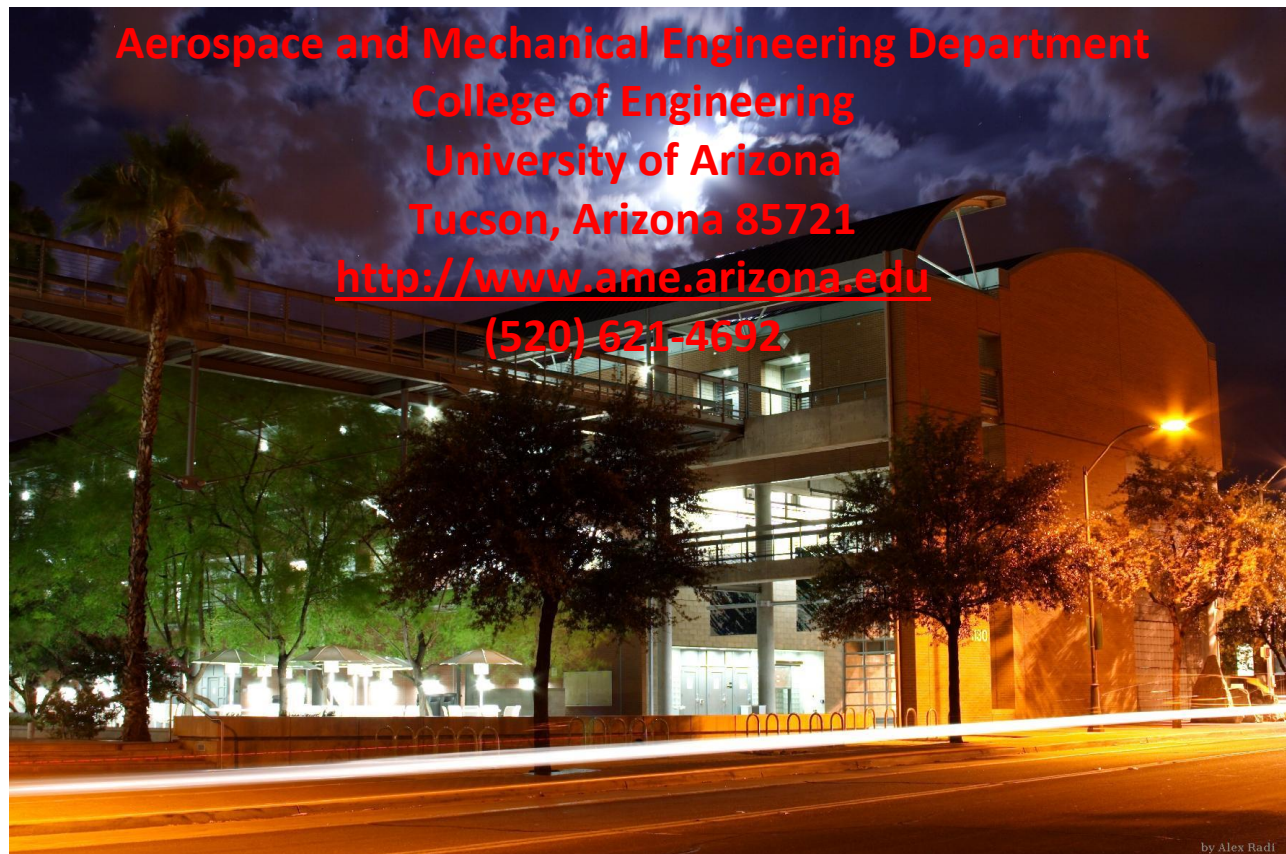


# HANDBOOK OF GRADUATE PROGRAMS

IN THE

## DEPARTMENT OF AEROSPACE & MECHANICAL ENGINEERING

March 2015



## TABLE OF CONTENTS

I.	Introduction .....	4
II.	Admission	
	A. General Admission Requirements.....	4
	B. Applying for Admission .....	5
	C. Application Deadlines .....	6
III.	Financial Aid	
	A. Types of Funding .....	7
	B. Eligibility for Departmental Funding .....	8
	C. Additional Mandatory Requirements for the Release of Funding/Awards to Recipients .....	8
	D. Applying for Additional Financial Aid through the Graduate College .....	9
IV.	Academic Advisor and Committee Member Selection	
	A. M.S. Thesis/Report Committee.....	10
	B. Ph.D. Comprehensive Exam Committee.....	11
	C. Ph.D. Oral Defense Examining Committee .....	11
V.	M.S. Degree Requirements and Procedures	
	A. Timeline for Satisfactory Progress Toward Degree – M.S. ....	13
	B. M.S. Thesis versus Master’s Report versus Coursework Only Option .....	13
	C. M.S. Program Course Requirements	
	1. AME 500A and 500B (Advanced Engineering Analysis) .....	15
	2. AME 696G (Graduate Seminar) .....	15
	3. M.S. Core Area Course Requirements.....	15
	4. Options .....	16
	5. Additional Non-AME Coursework and Transfer Credit .....	16
	D. Required GradPath Forms .....	17
	E. M.S. Steps to Graduation	
	1. Confirming Your Expected Graduation .....	17
	2. Enrollment Requirements .....	17
	3. Final Oral Examination/Defense – M.S. ....	18
VI.	Ph.D. Degree Requirements and Procedures	
	A. Timelines for Satisfactory Progress Toward Degree	
	1. Completed M.S. to Ph.D. Path.....	20
	2. Direct B.S. to Ph.D. Path .....	21
	B. Ph.D. Program Requirements	
	1. Overview of General Course Requirements .....	22
	2. Transfer Credit.....	23

**TABLE OF CONTENTS (continued)**

<b>3. Qualifying Examination</b>	
a. Deadlines for Completing the Examination .....	<b>23</b>
b. Qualifying Exam Structure and Policy .....	<b>24</b>
<b>4. GradPath Doctoral Plan of Study.....</b>	<b>24</b>
<b>5. Oral Comprehensive Examination .....</b>	<b>25</b>
a. Written Portion (Proposal) Structure and Pass Policy	
i. Major Area .....	<b>25</b>
ii. Minor Area.....	<b>26</b>
iii. Pass Policy.....	<b>26</b>
b. Oral Portion of the Comprehensive Exam	
i. Scheduling the Examination.....	<b>26</b>
ii. Oral Comp Exam Structure.....	<b>27</b>
iii. Results of the Oral Comprehensive Examination .....	<b>27</b>
<b>6. Prospectus/Proposal Confirmation .....</b>	<b>27</b>
<b>7. AME 696G Seminar Presentation .....</b>	<b>27</b>
<b>8. Final Oral Dissertation Defense and Graduation</b>	
a. Enrollment Requirements .....	<b>28</b>
b. Final Ph.D. Oral Examination/Defense and Graduation.....	<b>28</b>
<b>C. Minor in Aerospace or Mechanical Engineering.....</b>	<b>29</b>
<b>Appendix A: Application for Department Funding – Continuing Students .....</b>	<b>30</b>
<b>Appendix B: AME Graduate Student Advising-Mentoring Forms.....</b>	<b>32</b>
<b>Appendix C: Master’s and Ph.D. Program Checklists.....</b>	<b>34</b>

## I. INTRODUCTION

This booklet is prepared for the benefit of graduate students enrolled in the graduate programs (M.S., Ph.D., and M Eng) of Aerospace Engineering and Mechanical Engineering, who are interested in matriculating in these programs. The objective of this handbook is to provide clarification on the Aerospace & Mechanical Engineering (AME) Department's procedures for admission and matriculation of students, and to give students an overview of the department's expectations for the student as related to the completion of these graduate programs.

Please note that the general degree requirements and regulations of the Graduate College are clearly stated at the Graduate College website (<http://grad.arizona.edu/degrecert>) and are not repeated here. Students are urged to become familiar with all the regulations governing the degree requirements, as **it is the student's responsibility to discuss these requirements with their advisors and ensure that all of these requirements are satisfied at graduation.**

The graduate program in the Department is administered by the Graduate Studies and Research Committee (GSRC), which consists of several faculty members and a graduate student representative. Any serious concern that a student may have should first be discussed with his/her academic advisor and then, if necessary, submitted in writing to the AME Department's Graduate Administrative Associate, who will submit the issue for discussion by the Graduate Studies and Research Committee.

## II. ADMISSION

### A. General Admission Requirements

Admission to the AME graduate programs is granted based on a holistic evaluation of applicants' credentials, including undergraduate and/or graduate GPA, GRE scores, personal statement, research experience, and letters of recommendation. As such, the admission requirements listed below are included as general guidelines for admissions consideration:

- (1) A Bachelor of Science degree from an aerospace, mechanical, or nuclear engineering curriculum of a recognized institution of higher education is required of all applicants to the graduate program. A grade average of "B+" or better in all previous university-level academic work is expected, particularly for coursework undertaken in advanced mathematics and engineering courses. Graduates from other engineering, mathematics, and physical sciences curricula may be admitted provisionally, subject to the completion of any undergraduate courses recommended by the Department. No graduate credit will be allowed for these undergraduate courses.
- (2) Applicants are required to take the GRE exam. Applicants' scores are expected to be in the top 25 percentile on the Quantitative and Analytical parts.
- (3) For INTERNATIONAL APPLICANTS: International students must submit TOEFL/IELTS scores supporting that they meet the minimum English proficiency requirement in order to be considered for admission. This English Proficiency requirement may be satisfied in the following ways:

- a. Applicants may provide **TOEFL (Test of English as a Foreign Language)** examination scores. TOEFL examination scores must be dated no more than 2 years prior to the term of application. For the internet-based TOEFL exam, a minimum score of 79 is required for the applicant to be considered for admission.
- b. **IELTS (International English Language Testing System)** scores are also acceptable and require a minimum composite score of 7, with no subject area score falling below a 6. IELTS examination scores must be dated no more than 2 years prior to the term of application.
- c. **Conditional Admission:** The AME Department will consider an applicant for Conditional Admission only if the applicant's current TOEFL or IELTS scores do not meet the TOEFL/IELTS standards listed above, and the candidate meets all of the other departmental requirements. Conditional Admission requires that the applicant apply to and enroll at the UA Center for English as a Second Language (CESL) at their own cost (or their sponsor's) with the expectation of achieving English proficiency within one year. Additional information regarding conditional admission may be found at <https://grad.arizona.edu/admissions/admissions-types/conditional-admission>; information regarding the CESL program may be found at [cesl.arizona.edu](https://cesl.arizona.edu).

**Special Notes:** It is important to note that any applicant who has previously earned a Master's degree cannot be admitted into a second Master's degree program if the curricula for both Masters programs are the same or similar (i.e., have more than 6 units of overlapping course requirements). Likewise, an applicant who has previously earned a Ph.D. in an area of study similar to Aerospace/Mechanical Engineering cannot be admitted to an AME M.S. or Ph.D. program.

In addition, please note that concurrent admission and enrollment in two or more Master's programs at the University of Arizona must be approved by the AME Director of Graduate Studies; however, concurrent enrollment in two or more Ph.D. programs is not permitted.

## **B. Applying for Admission**

Applicants may apply to AME graduate program through the Graduate College website (<http://grad.arizona.edu/admissions/apply-now>). Applicants to the M.S. and Ph.D. programs must submit the following items with their online application in order to be considered for admission:

- (1) three letters of recommendation;
- (2) transcripts from all previously-attended universities (electronic/scanned copies may be submitted with the online application; however, the Graduate College will require original transcripts if admission is granted);
- (3) a personal statement/statement of purpose;
- (4) GRE general test scores;
- (5) International Applicants must submit TOEFL or IELTS scores supporting that they meet the minimum English proficiency requirement in order to be considered for admission.

### **C. Application Deadlines**

ALL applicants who wish to be considered for departmental funding must apply and submit an online application for admission **by December 1<sup>st</sup> for Fall admission and by June 1<sup>st</sup> for the Spring admission**. See the next section of this Handbook, “Financial Aid” for additional information regarding departmental funding.

Applicants who do not require funding may submit online applications (for admission) by the following deadlines:

- **Domestic applicants** may apply any time **before June 1st for Fall admission and before October 1<sup>st</sup> for Spring admission**.
- **International applicants** must apply **by December 1<sup>st</sup> for Fall admission and by June 1<sup>st</sup> for Spring admission**. (IMPORTANT: Once admitted, all international students are required to attend the International Graduate Student Orientation before being permitted to enroll in classes. The International Student Orientation is generally held at the beginning of the Fall and Spring semesters. For this reason, it is recommended that admitted international students arrive at the University of Arizona two weeks before the start of classes for the semester. Additional information regarding the International Graduate Student Orientation can be found at the International Student Services website ( <http://internationalstudents.arizona.edu/students-orientation>).

### III. FINANCIAL AID

#### A. Types of Funding

The AME Department offers funding in the form of graduate assistantships (teaching and research assistantships), student worker positions, traineeships, fellowships, and scholarships including:

- Graduate Assistantships – In addition to a salary, graduate assistantship (GA) positions carry both tuition and health insurance benefits. Graduate Assistantships are offered as Research Assistants or Teaching Assistantships, and as  $\frac{1}{4}$  or  $\frac{1}{2}$  time positions:
  - Teaching Assistantship (TA) – Salaried teaching assistantships may vary in terms of responsibilities (Unlimited Instructional or Limited), and time commitment ( $\frac{1}{4}$  Teaching Assistantship = 10 hours per week;  $\frac{1}{2}$  Teaching Assistantship = 20 hours per week). Thus, it is imperative that students develop a research-relationship with a faculty member so that financial support after the first year of study may be shifted to a research assistantship.
  - Research Assistantship (RA) – Salaried research assistantships are awarded by individual faculty to those applicants whose backgrounds and areas of interest are matched to the needs and interests of the faculty member. Benefits associated with Research Assistantships, as for Teaching Assistantships, vary with time commitment ( $\frac{1}{4}$  Research Assistantship = 10 hours per week;  $\frac{1}{2}$  Research Assistantship = 20 hours per week). Applicants are encouraged to review the listing of AME faculty and their research interests at the AME website (<http://www.ame.arizona.edu>).
  - Benefits with  $\frac{1}{2}$  time RA or TA positions: Students who accept  $\frac{1}{2}$  time employment, either as a single  $\frac{1}{2}$  time Research Assistantship or  $\frac{1}{2}$  time Teaching Assistantship, or as a combination of  $\frac{1}{4}$  time Research Assistantship and  $\frac{1}{4}$  Teaching Assistantship, receive a waiver of both full non-resident tuition (if they are not Arizona residents), as well as 100% registration remission/waiver of full resident tuition, and health insurance coverage.
  - Benefits with  $\frac{1}{4}$  time RA or TA positions: Students who accept  $\frac{1}{4}$  time employment, either as a single  $\frac{1}{4}$  time Research Assistantship or  $\frac{1}{4}$  time Teaching Assistantship, receive a waiver of full non-resident tuition (if they are not Arizona residents) of approximately \$7,800 per semester, as well as 50% registration remission/waiver of resident tuition (approximately \$2,800 per semester), as well as health insurance coverage.
- Student Worker Positions – These positions are a form of employment that involve a fixed pay rate and generally a 10 hour per week commitment, which may include a variety of duties, depending on the nature of the assignment. These positions do not carry tuition or health insurance coverage benefits.
- Graduate Tuition Scholarships (GTS) are a type of funding which may include
  - Waiver of Non-Resident Tuition: This waiver waives the nonresident portion of tuition charged for non-Arizona domestic students and international students.
  - Registration Fee Waiver – Waiver of some portion or all of resident tuition.

- Graduate Fellowships are merit-based cash awards from the College of Engineering, Graduate College, or the University which may be distributed from any remainder in funds after all other types of funding have been awarded.

**B. Eligibility for Departmental Funding**

- NEW APPLICANTS may apply for funding by completing and submitting an online application for admission prior to the deadlines for funding consideration (by December 1<sup>st</sup> for Fall admission and by June 1<sup>st</sup> for Spring admission). Applicants are eligible for departmental funding consideration only after having accepted an offer of admission from the Graduate College. Financial aid is awarded on a merit basis. Students' grade point average, GRE General and TOEFL scores, letters of recommendation, and experience in teaching and research are considered when evaluating applicants. Please note that there are generally fewer openings for aid available in the Spring semester, as most of the financial aid available for the academic year may have been committed in the Fall semester. **Please note that students who plan to pursue or have chosen the Coursework Only option of the Aerospace Engineering or Mechanical Engineering M.S. programs are not eligible to receive financial aid through the University.**
- CURRENT GRADUATE STUDENTS may apply for funding by completing the AME Department Application for Teaching Assistantship, Student Worker Positions, and GTS (see Appendix A of this Handbook). It is important to note that the renewal of any financial award is contingent on the student satisfying all requirements for the award. In the case of a teaching assistantship, this includes a minimum overall evaluation of "Adequate to High" by the faculty supervisor from the student's previous semester's teaching assistantship. Graduate students seeking departmental funding in the form of Teaching Assistantships, Student Worker Positions, and GTS must submit this form for each semester for which they are requesting funding.

**C. Additional Mandatory Requirements for the Release of Funding/Awards to Recipients**

Once the department has approved a funding request for a student who has accepted admission to the University of Arizona, it is important that the student complete some additional steps with the Graduate College and the Office of Scholarships and Financial Aid before this funding can be released to the student:

- (1) All graduate students in the College of Engineering who receive financial aid from or through the University of Arizona are expected to be full-time students and should enroll for some combination of coursework, research, or independent study that results in at least 12 units of credit each semester.
- (2) International students who are applying for teaching assistant positions should have completed the iBT internet based TOEFL with a score of 24 or higher in the Speaking subtest. Any students who have not obtained a score of 24 or higher on the TOEFL Speaking subtest must have his/her English speaking and comprehension skills evaluated by an AME departmental committee. These evaluations take place once a semester, typically within the first two weeks of the semester, and produce two scores: (1) a score that reflects each student's English speaking and comprehension skills, and (2) a score reflecting the readiness of the student for Unlimited TA versus Limited TA positions based on their English speaking and comprehension.



- (3) Teaching Assistant Training Online (TATO) is an online training module about teaching and learning that is made available through D2L. All students who want to be employed as TAs must review the module *Staying Out of Trouble: UA Policies* and pass the test at the end of the module with a score of 95% or higher no later than two weeks after the start of classes. For instructions on login, registration and access to TATO, see <http://grad.arizona.edu/ta/tato>.

#### **D. Applying for Additional Financial Aid through the Graduate College**

Graduate students may apply for additional funding opportunities, other than department-awarded assistantships and field-specific fellowships and traineeships, through the Graduate College. Information regarding these opportunities for funding can be found at <http://grad.arizona.edu/diversity/funding>.

Beginning with the 2012-13 academic year, all graduate students who wish to be considered for additional funding in the form of Graduate College Fellowships must show a level of need before these funds can be released. To demonstrate a level of need:

- Domestic Students must file the **Free Application for Federal Student Aid** (FAFSA, see [www.fafsa.ed.gov](http://www.fafsa.ed.gov)) before these funds can be disbursed.
- International Students must submit the **Financial Aid Calculation for International Students in Masters/Doctoral Programs** to the Graduate Administrative Associate, who will forward it to the Office of Student Financial Aid (OSFA) for review. This application can be found on the Graduate College website <http://grad.arizona.edu/financial-resources/ua-resources/meritorious-awards>. Please note that it is the last page of this document, along with the Estimated Family Contribution worksheet, that must be submitted to [OSFA-DeptAskAid@email.arizona.edu](mailto:OSFA-DeptAskAid@email.arizona.edu).

#### IV. ACADEMIC ADVISOR AND COMMITTEE MEMBER SELECTION

It is the responsibility of the student to reach agreement with a professor who will serve as their advisor during their first year of residence. For this purpose, during the first semester of residence, the student should become acquainted with the areas of interest of the individual professors and the research projects underway in the Department. The AME web site (<http://ame.engr.arizona.edu/research-areas>) provides a listing of faculty specializations and research. It is imperative that students who choose to pursue an M.S. (either thesis or Master's report option) or a Ph.D. identify a thesis/report/dissertation advisor; this faculty member generally serves as the student's academic advisor.

If the student is supported by a Research Assistantship related to a specific faculty member's research program, that faculty member generally serves as the student's academic advisor. **For incoming graduate students who do not have a Research Assistantship or who have not identified an advisor prior to arrival, the Associate Department Head of Graduate Studies will serve as the academic advisor.** The Associate Department Head may serve as the temporary academic advisor for the student (until the student identifies a thesis/report or dissertation advisor) or may agree to serve as the student's thesis/report or dissertation advisor on a permanent basis.

Prior to the start of their first semester in the M.S. or Ph.D. program, students must meet with their academic advisor or with the Associate Department Head of Graduate Studies to discuss their study program and courses for enrollment. For the first two semesters of residence, new and second-term students must fill out the AME Graduate Student Advising-Mentoring Form (see Appendix B) before meeting with their advisor to plan their studies one semester in advance. This form is a means by which the advisor can monitor the student's initial progress in the program and provide guidance for scheduling graduate courses.

In addition to advising the student regarding the selection of appropriate classes for the completion of his/her program, the academic advisor should be consulted if the student subsequently decides to make substantial changes in his/her study program or experiences unusual difficulties.

##### **A. M.S. Thesis/Report Committee**

Master's thesis/report committees must consist of **three members**, of which at least two must be current tenure/tenure-track UA faculty members from the AME Department. For Master's students, the thesis/report advisor serves as both the student's academic advisor and as the chair of their thesis/report committee.

After a research project has been selected in consultation with the thesis/report advisor, the student should invite two tenure/tenure track professors to serve as examiners in the final oral examination. Alternatively, if the thesis advisor and one additional member of the committee are both tenure/tenure track professors in the department, the remaining third committee member may be a retired AME faculty member or a member from industry. In such cases,

these members must be approved via a special member request form at least two weeks prior to the thesis or report defense. It is important to note that a special member may serve as the co-chair of a committee, along with a regular tenured or tenure-eligible faculty member as the other co-chair, but a special member may not serve as sole chair of a committee.

See the AME Department Graduate Administrative Associate if you plan to include a special member in your thesis committee; the Administrative Associate will submit a special member request (<https://grad.arizona.edu/gcforms/degree-certification-forms>) from the department along with the individual's CV to the Graduate College for approval.

#### **B. Ph.D. Comprehensive Examination Committee**

Each student's Ph.D. major advising committee consists of the Major/dissertation advisor and two tenure/tenure track faculty members from the AME Department, as well as a tenure/tenure track faculty member from the student's Minor area. It is the duty of the Ph.D. advising committee to guide the student through the research for the dissertation and to conduct the comprehensive examination.

Normally, the written and oral portions of the comprehensive examination should take place at least three months prior to the Final Oral Examination (defense of dissertation). The examining committee for the Comprehensive Examination must consist of **a minimum of four members**, including

- (1) the Major Advisor;
- (2) two additional members who are tenured, or tenure track faculty members in the AME department.
- (3) The fourth member of the committee must be able to cover material related to the student's Minor area. The Minor department controls the minor portion of the written examination and may waive participation of a Minor department faculty member at their discretion; however, if so, the Minor area department must approve a fourth member from the AME Department to participate in the comprehensive exam committee and to cover material related to the Minor area. The fourth member may be tenured or tenure-track, or a special member. See the AME Department Graduate Administrative Associate if you plan to include a special member in your comprehensive exam committee.

#### **C. Ph.D. Oral Defense Examining Committee**

Although the Graduate College generally requires the Oral Defense Examining Committee to have a **minimum of three members** (all of whom must be AME tenure/tenure-track faculty), typically the four members of the comprehensive exam committee are named to the oral defense examining committee as well. However, if the Minor department decides to waive participation of a Minor department faculty member in the final oral defense, it is not necessary to designate a fourth member to represent the Minor department for the final oral defense. On the other hand, either the dissertation advisor or the minor department may request the addition of one or more representatives of the minor field to the committee.

It is important to note that, if a committee has only three members, all must approve the dissertation. In departments that require four or five members, there may be one dissenting vote.

All dissertation committee members are expected to attend the final defense. Should special circumstances require a member to attend remotely, prior permission from the Graduate College must be obtained. See the AME Department Graduate Administrative Associate if a member of your final oral defense examining committee is planning to participate in your defense remotely.

## V. M.S. DEGREE REQUIREMENTS AND PROCEDURES

### A. Timeline for Satisfactory Progress Toward Degree - M.S.

Year	Timeline
Year 1	<p>Meet with graduate advisor to determine study plan; complete <b>AME Graduate Student Advising-Mentoring Form</b> (see Appendix B).            Complete AME 500A and 500B.            Complete two semesters of AME 696G.            Complete core courses offered during first year.            For report or thesis track, identify research area and advisor            Submit <b>Responsible Conduct of Research Statement</b> online via GradPath.            Submit <b>Transfer Credit Form</b> via GradPath if you want coursework from other institutions to be applied to your program.            (Semester 2) <b>Master's/Specialist Plan of Study</b> to be submitted online via GradPath.</p>
Year 2	<p>Meet with graduate advisor and update Plan of Study, if necessary. Send all changes to the Graduate College.            Complete all necessary coursework.            Complete research and write-up of Thesis/Report.            Select examination committee and schedule your defense. The exam date should be early enough in the semester to complete revisions by Graduate College submission deadlines.</p> <ul style="list-style-type: none"> <li>- Submit <b>Master's/Specialist Committee Appointment Form</b> via GradPath. This form is required for students in <b>all</b> M.S. programs – Thesis, Master's Report, Coursework Only.</li> <li>- Give copy of Thesis/Report to Committee Members 2 weeks prior to defense.</li> <li>- Schedule room (and projector) for defense; provide date and time of defense to the Graduate Administrative Associate.</li> <li>- Complete M.S. Checklist for your department file (see Appendix C).</li> </ul> <p>After thesis/report defense:</p> <ul style="list-style-type: none"> <li>- Complete all revisions.</li> <li>- Submit bound copies to Department Graduate Administrative Associate and advisor/committee members.</li> <li>- Graduate Administrative Associate will submit Change of K Grades form to Graduate College as well as notify Graduate College that you have completed your degree requirements.</li> </ul> <p>Make graduation plans; let the Business Manager know if you plan to walk in PreCommencement; submit PowerPoint slide with bio; purchase announcements/tickets.</p>

### B. M.S. Thesis versus Master's Report versus Coursework Only Option

Students may choose a thesis, master's report option, or non-thesis/coursework only option. It is important that students only enroll in courses that correspond with their option (AME 910 for Thesis and AME 909 for Master's Report), as the Graduate College cannot enter passing grades on courses that do not correspond with the option students have specified on their Master's Plan of Study. Master's Program Options include:

- **MS Thesis Option (AME 910)** - The thesis option consists of 26 units of coursework, plus 6 units of Thesis (AME 910). Students who choose the thesis option must complete a thesis and pass a final oral examination. **The examination lasts from one to two hours and includes a defense of the research results.** Part of the questioning may involve coursework listed on the student's study program. The examination is open to the public. Generally, the student presents his/her thesis work, and then a brief question

period is open to the public, followed by a closed examination period by the M.S. Thesis/Report Committee. No independent study units or AME 900 research units are allowed for the thesis option.

- **Master's Report Option (AME 909)** - The report option consists of 29 units of coursework, plus 3 units of Master's report (AME 909). No other independent study units are allowed for the report option. Students who choose the report option must complete a report and pass a final oral examination. This examination consists of a 30-minute presentation by the student followed by 15 minutes of questioning. The presentation will be open to the public, but the question period will be closed. The exam should not exceed 1 hour.
- **Non-Thesis/Coursework Only Option** - This option is not available to students who have received financial support from the University in the form of teaching or research assistantships or fellowships. The non-thesis option consists of 32 units of coursework following the general requirements of the M.S. degree program. A maximum of 3 units of Independent Study (AME 599) or 3 units of research (AME 900) may be included in the study program. A student who wishes to enroll in independent study must make arrangements for supervision by a faculty member in the Department and submit the independent study proposal form to the Graduate Administrative Associate. The non-thesis option does not require a final oral examination.

### C. **M.S. Program Course Requirements**

The AME Master of Science program course requirements vary somewhat for Thesis, Master's Report and Non-Thesis/Coursework only options, but mandatory requirements include:

- 6 units, Advanced Engineering Analysis (AME 500A and 500B);
- 2 units of Graduate Seminar (AME 696G);
- 9 units/ 3 courses from a Core Area (see Core Area section on following page);
- 6 units of Thesis (AME 910) or 3 units of Master's Report (AME 909) (*not required for Non-Thesis/Coursework only students*).
- No more than 6 units of non-AME courses are permitted.

Important Note for Master Students who plan to Continue to Ph.D.: Students planning to continue their graduate studies toward the Ph.D. degree in the AME Department are strongly advised to read the Ph.D. Program Course Requirements section of this Handbook and the separate booklet entitled, "Qualifying Examination Guidelines" before selecting their program of study for the M.S. degree. The student will find that the Ph.D. requirements may have a strong impact on their choice of courses for the M.S. degree. If you decide to pursue a Ph.D. after completing your M.S., you will be required to submit a new application for admission to the Ph.D. program.

**1. AME 500A and 500B (Advanced Engineering Analysis)**

All M.S. students are required to complete Advanced Engineering Analysis (500A and 500B) to satisfy the AME math requirement. In order to receive graduate credit, students must earn at least a C in 500A and 500B. Those students who are unable to obtain graduate credit (because of a D or E) may retake these courses as Independent Study courses (AME 599 for 3 units). The student must inform the instructor of 500A/B that a course is being repeated, complete all assignments, tests and final exam, as required by the instructor, and obtain a grade of S (superior) or P (pass). Note, however, that the original grades in 500A/B will appear on the transcript and in the calculation of the GPA, whereas the new grade earned in the Independent Study will not be included in the calculation of the GPA (University Policy).

If a student originally receives D's or E's in both 500A and B or is unable to earn S or P in the independent study courses as described above, the student is automatically disqualified from all AME graduate programs.

**2. AME 696G (Graduate Seminar)**

All M.S. students are required to complete 2 units of AME Graduate Seminar (696G). Grades for AME 696 are granted based on participation and attendance.

**3. M.S. Core Area Course Requirements**

Each student **must** choose one core area. The purpose of the core area requirement is to ensure that each student receives a grounding in one core discipline of Aerospace and Mechanical Engineering, which prepares our MS graduates either for professional work or for advanced study. The core areas are Dynamics and Control Systems, Fluid Mechanics, Solid Mechanics and Dynamics, and Thermal Sciences. Students must complete three courses, including at least one with a computational emphasis, from the chosen core area, as follows:

DYNAMICS AND CONTROL SYSTEMS

Chose TWO, or take all THREE classes	AME 550 Advanced Dynamics	ECE 542 Digital Control	Choose ONE, if only two selected from the left side
	AME 553 Computational Multi-body Dynamics	ECE 543 Nonlinear Control Systems	
	AME 558 Advanced Modern Control Theory of Mechanical Systems	AME 560 Advanced Vibration	

FLUID MECHANICS

Choose at Least TWO	AME 536A Fundamentals of Fluid Mechanics	AME 531/431 Numerical Methods in Fluid Mechanics and Heat Transfer	Choose at least ONE
	AME 536B Fundamentals of Fluid Mechanics	AME 561 Finite Element Methods	
	AME 536C Compressible Fluid Dynamics		

SOLID MECHANICS AND DYNAMICS

Choose at least TWO	AME 564A Mechanics of Deformable Solids	AME 561 Finite Element Methods	Choose at least ONE
	AME 564B Mechanics of Deformable Solids	AME 563 Advanced Finite Element Analysis	
	AME 550 Advanced Dynamics	AME 553 Computational Multi-body Dynamics	

THERMAL SCIENCES

Must take both	AME 530 Advanced Thermodynamics/Radiation	AME 531/431 Numerical Methods in Fluid Mechanics and Heat Transfer	Choose at least ONE
	AME 532 Conduction/Convective Transport Phenomena	AME 561 Finite Element Methods	

**4. Options**

Student may choose one option. The purpose of each option is to provide a concentration in one area of specialization, leading to a career track supported by the curriculum and faculty in the Aerospace and Mechanical Engineering Department.

Options in the MS in Aerospace or Mechanical Engineering include:

- **Microelectromagnetic Systems (MEMS)** - To complete the option students must take AME 586, AME 588, AME 589A and one course from the following list: AME 583, ECE/MSE 546, ECE 565, CHEE 537, MSE 572, OPTI 580, MSE 562, ECE 584, ECE 552. Students completing the option are only required to complete two courses from a core area.
- **Biomechanical** - To complete this option a student must take both AME 566 and AME 583 and either AME 561 or AME 563.

**5. Additional Non-AME Coursework and Transfer Credit**

A maximum of 6 units of graduate coursework taken at another institution may be transferred. Students wishing to apply transfer coursework from other institutions to their graduate career must submit a Transfer Credit Form via GradPath (see <https://grad.arizona.edu/gcforms/academic-services-forms>).

Please note that transfer coursework should be submitted for evaluation before the end of the student's first year in residence, and that this evaluation serves as a preliminary approval process. The transfer coursework will not be applied to the student's AME program until the pre-approved transfer coursework is approved by the department on the student's Master's/Specialist Plan of Study form.

Generally, up to 6 units of courses may be taken outside the AME Department, in either mathematics, physical or biological sciences, in other branches of engineering, or management.



**Special Note:** AME students who have received credit for AME 4XX are not permitted to receive graduate credit for AME 5XX in a combined AME 4XX/5XX course. The only exceptions are the following design courses -- AME 520, 522, and 528 -- which offer considerable latitude for enriching the graduate-level design experience.

#### **D. Required GradPath Forms**

All M.S. students must submit the following forms online via GradPath (see <https://grad.arizona.edu/gcforms/academic-services-forms>):

- **Responsible Conduct of Research Statement:** This form is the first in the series of GradPath forms to be completed by each student and must be completed before any other forms can be completed.
- **Plan of Study:** This form must be submitted during the second semester in residence. The Plan of Study describes the coursework you have completed and intend to complete toward the fulfillment of your degree, and also sets your expected graduation date and your major advisor. If you have previously submitted a Transfer Credit Form via GradPath, the Plan of Study form will allow you to submit these preapproved courses to your advisor for approval to be applied toward your graduate career. Please note that a course with a grade of “D” assigned cannot be submitted on the plan.
- **Master’s Specialist Committee Appointment Form.** This form is required for students in all M.S. programs – Thesis, Master’s Report and Coursework Only. The Committee Appointment Form must be submitted in the semester in which you plan to graduate. In this form you are asked to provide information about your committee members and your expected graduation date.

#### **E. M.S. Steps to Graduation**

##### **1. Confirming Your Expected Graduation**

**IMPORTANT: ALL M.S. students** (Thesis, Master’s Report and Coursework Only) who are planning to graduate must submit the **Master’s Specialist Committee Appointment Form** in GradPath. In addition, graduating M.S. students must:

1. Confirm the Expected Graduation Date with the Graduate Administrative Associate and the Graduate College.
2. Let the Business Manager know if you plan to walk in PreCommencement and submit a PowerPoint slide with a bio for the PreCommencement Ceremony, purchase tickets, and reserve a cap/gown.

##### **2. Enrollment Requirements**

All M.S. students must maintain continuous enrollment until graduation. Graduate College requirements for continuous enrollment are available at the Graduate College website

<http://grad.arizona.edu/academics/policies/enrollment-policies/continuous-enrollment> .

Any M.S. student planning to defend and graduate in a Fall or Spring semester must be registered for that semester for a minimum of 3 graduate units. If the student is planning to defend and graduate in a summer term, the student must register for a minimum of 1 unit of graduate credit during that term. However, international students and students who are receiving financial assistance in the form of assistantships, fellowships, loans, grants, scholarships, traineeships, or sponsorships may have to register for more units to maintain appropriate visa status or their funding status. It is important to note that, while enrollment in 1 unit satisfies the requirement for continuous enrollment, it does NOT meet requirements for full-time status.

### **3. Final Oral Examination/Defense – M.S.**

For M.S. Thesis students, the final oral examination may be scheduled after the thesis has been approved by the examining committee, provided that the student has completed his/her coursework or is in his/her final semester. The final thesis oral examination lasts from one to two hours and includes a defense of the research results. Part of the questioning may involve coursework listed on the student's study program. The examination is open to the public. Generally, the student presents his/her thesis work, followed by a brief question and answer period. Lastly, there is a closed examination period by the M.S. Thesis/Report Committee.

For M.S. Report students, the final oral examination consists of a 30-minute presentation by the student followed by 15 minutes of questioning. The presentation will be open to the public, but the question period will be closed. The exam should not exceed 1 hour.

For Non-Thesis/Coursework Only students, no final oral examination is required.

Once a student has completed all of the course requirements for his/her program and is ready to prepare for a final thesis oral examination (defense), the following steps must be completed:

1. The scheduling of the final oral examination and the fulfillment of all requirements relating to this examination are the sole responsibility of the student. In scheduling the defense date and time, students must consider:
  - a. the availability of their thesis committee members;
  - b. that a copy of the thesis must be submitted to the M.S. Thesis/Report Committee members 2 weeks prior to the date of the defense;
  - c. the availability of the room and laptop projector for their defense;
  - d. the allowance of ample time after the defense to complete all necessary revisions. Revisions must be completed by the semester deadlines posted by the Graduate College (see <http://grad.arizona.edu/academics/degree-certification/deadlines-for-graduation>). Failure to complete the revisions and submission of the final bound copy of the thesis by the semester deadlines will result in the expected graduation date for the student being rolled to the following semester, with required enrollment for that semester.
2. Inform the Department Graduate Administrative Associate of the date, time, and place of the defense.

3. Students must submit a copy of their thesis/report to their M.S. Thesis/Report Committee members two weeks prior to the date of their defense. It is imperative that the format of the thesis/report be consistent with Graduate College guidelines (see <http://grad.arizona.edu/degrecert/manuals>). In addition, copies of completed theses/reports may be found in the AME Room N711.
4. Following the defense, the thesis/report advisor/committee chair will email the result of the examination (Pass, Pass with Revisions, or Fail) to the Graduate College and Graduate Administrative Associate. If no major revisions are required, the Department Graduate Administrative Associate will complete a Change of K Grades form once the student has completed their final oral examination. If major revisions are required, these forms will not be submitted to the Graduate College until all revisions have been completed and a bound copy has been submitted to the Department.
5. **Please note that the AME department will not certify that all requirements have been met for the degree until a bound copy has been submitted to the Department Administrative Associate for the AME department library.** The name of the type of binding required for this bound copy is VELO. Samples of bound theses/reports may be found in the AME Room N711. Students should also check with their thesis advisor and committee members as to whether each will also require a bound copy. The Graduate College does not require Master's students to archive their Thesis with the University Library; however, some Thesis chairs may require that a Master's student archive their Thesis with the University Library.
6. Once the bound, final copy of the thesis/report is submitted to the Department, the Graduate Administrative Associate will submit the Master's/Specialist Completion Confirmation form to the Graduate College.

In the event of failure, the M.S. Thesis/Report Committee will determine the steps that the student must complete before a second examination may be scheduled. Upon recommendation of the Graduate Studies and Research Committee (GSRC), a second examination will be granted after a lapse of at least one semester. The examining committee must be the same as for the first examination, except that a representative (a fourth AME faculty member) may preside. A third final examination will not be granted.

## VII. PH.D. DEGREE REQUIREMENTS AND PROCEDURES

### A. Timelines for Satisfactory Progress Toward Degree

#### 1. Timeline - Completed M.S. to Ph.D. Path

Year	Timeline
Year 1	<p>Meet with graduate advisor to determine study plan; complete <b>AME Graduate Student Advising-Mentoring Form</b> (see Appendix B).</p> <p>Complete two semesters of AME 696G and courses according to study plan.</p> <p>Identify dissertation area and advisor.</p> <p>Submit <b>Responsible Conduct of Research Statement</b> online via GradPath.</p> <p>Submit <b>Transfer Credit Form</b> via GradPath if you want coursework from other institutions to be applied to your program.</p> <p><b>Ph.D. students who completed their M.S. previously at the University of Arizona should prepare for and pass the Qualifying Examinations no later than Year 1, Semester 2.</b></p>
Year 2	<p>(Semester 1) Submit <b>Doctoral Plan of Study</b> online via GradPath.</p> <p><b>Ph.D. students who completed their M.S. elsewhere should prepare for and pass the Qualifying Examinations no later than Year 2, Semester 1.</b></p> <p>Begin doctoral research.</p> <p>Complete additional courses and 696G according to study plan.</p> <p>Select minor area courses.</p>
Year 3	<p>Complete all coursework.</p> <p>Continue with research.</p> <p>Form comprehensive examination committee and submit <b>Comp Exam Committee Appointment Form</b> online via GradPath.</p> <p>Schedule comprehensive exam.</p> <p>Submit <b>Announcement of Doctoral Comprehensive Exam</b> in GradPath.</p> <p>Pass comprehensive examinations in major and minor areas (Semester 1, Year 3).</p> <p>Comp Exam Committee Chair will submit <b>Results of Comprehensive Examination</b> in GradPath.</p>
Year 4	<p>Select committee for final examination; submit <b>Doctoral Dissertation Committee Appointment</b> form in GradPath.</p> <ul style="list-style-type: none"> <li>- Submit an approved dissertation prospectus/proposal (signed or initialed by your advisor) to the Department Graduate Administrative Associate.</li> <li>- Complete Ph.D. Checklist for your department file (see Appendix C).</li> </ul> <p>Complete research.</p> <p>Present dissertation research at AME 696G seminar.</p> <p>Prepare dissertation.</p> <p>Schedule and Pass Final Examination. Schedule room (and projector) for dissertation defense; provide date and time of defense to the Graduate Administrative Associate.</p> <p>Submit <b>Announcement of Final Oral Defense</b> form in GradPath <b>no later than 7 days prior to exam.</b></p> <p>After final oral exam, the Chair of your Oral Defense Examining Committee will submit the <b>Results of Final Oral Defense</b> via GradPath.</p> <p>After dissertation defense:</p> <ul style="list-style-type: none"> <li>- Complete all revisions.</li> <li>- Submit bound copies to Department Graduate Administrative Associate and advisor/committee members.</li> <li>- Graduate Administrative Associate will submit Change of K Grades form to Graduate College.</li> </ul> <p>Make graduation plans; let the Business Manager know if you plan to walk in PreCommencement; submit PowerPoint slide with bio; purchase announcements/tickets.</p>

## 2. Timeline - Direct B.S. to Ph.D. Path

Year	Timeline
Year 1	<p>Meet with graduate advisor to determine study plan; complete <b>AME Graduate Student Advising-Mentoring Form</b> (see Appendix B).</p> <p>Complete two semesters of AME 696G and courses according to study plan.</p> <p>Complete AME 500A and 500B.</p> <p>Identify dissertation area and advisor.</p> <p>Submit <b>Responsible Conduct of Research Statement</b> online via GradPath.</p> <p>Submit <b>Transfer Credit Form</b> via GradPath if you want coursework from other institutions to be applied to your program.</p>
Year 2	<p>(Semester 1) Submit <b>Doctoral Plan of Study</b> online via GradPath.</p> <p>Take AME 696G both semesters.</p> <p>Take core courses as needed to prepare for the Qualifying Examinations.</p> <p>Begin doctoral research.</p> <p>Select minor area courses.</p>
Year 3	<p><b>Ph.D. students with B.S. should take and pass the Qualifying Examinations in Year 3, Semester 1.</b></p> <p>Complete additional courses and AME 696G according to study plan.</p> <p>Continue with research.</p>
Year 4	<p>Complete all coursework.</p> <p>Continue with research.</p> <p>Form comprehensive examination committee and submit <b>Comp Exam Committee Appointment Form</b> online via GradPath.</p> <p>Schedule comprehensive exam.</p> <p>Submit <b>Announcement of Doctoral Comprehensive Exam</b> in GradPath.</p> <p>Pass comprehensive examinations in major and minor areas (Semester 1, Year 4).</p> <p>Comp Exam Committee Chair will submit <b>Results of Comprehensive Examination</b> in GradPath.</p>
Year 5	<p>Select committee for final examination; submit <b>Doctoral Dissertation Committee Appointment</b> form in GradPath.</p> <ul style="list-style-type: none"> <li>- Schedule room (and projector) for dissertation defense; provide date and time of defense to the Graduate Administrative Associate.</li> <li>- Submit an approved dissertation prospectus/proposal (signed or initialed by your advisor) to the Department Graduate Administrative Associate.</li> <li>- Complete Ph.D. Checklist for your department file (see Appendix C).</li> </ul> <p>Complete research.</p> <p>Present dissertation research at AME 696G seminar.</p> <p>Prepare dissertation.</p> <p>Schedule and Pass Final Examination. Submit <b>Announcement of Final Oral Defense</b> form in GradPath <b>no later than 7 days prior to exam.</b></p> <p>After final oral exam, the Chair of your Oral Defense Examining Committee will submit the <b>Results of Final Oral Defense</b> via GradPath.</p> <p>After dissertation defense:</p> <ul style="list-style-type: none"> <li>- Complete all revisions.</li> <li>- Submit bound copies to Department Graduate Administrative Associate and advisor/committee members.</li> <li>- Graduate Administrative Associate will submit Change of K Grades form to Graduate College.</li> </ul> <p>Make graduation plans; let the Business Manager know if you plan to walk in PreCommencement; submit PowerPoint slide with bio; purchase announcements/tickets.</p>

## B. Ph.D. Program Requirements

### 1. *Overview of General Course Requirements*

The AME Doctoral programs consist of a minimum of 57-59 units of graduate credit, depending upon the student's educational background (see table below), plus 18 units of Dissertation (AME 920). **IMPORTANT:** Students may not register for dissertation units (AME 920) until they have passed their Qualifying Examinations.

AME course requirements for the Ph.D. program include:

- 3-5 units of Graduate Seminar (AME 696G) depending on the student's educational background, as specified in the table below;
- 12-36 Major subject area units, depending on the student's educational background, as specified in the table below;
- 9-12 units in the minor, depending on the minor department requirement.

<b>RECENT</b> MS in AME or closely related discipline	<b>NOT RECENT</b> MS in AME or closely related discipline	<b>RECENT</b> BS in AME or closely related discipline
<p><b>*57</b> units of course work =</p> <p>3 units (semesters) of graduate seminars AME 696G**</p> <p>Minimum 12 units in area of major subject. Each student's transcript will be evaluated and, depending on background, a student may be required to take more than the minimum number of credits.</p> <p>Maximum of 6 units of individual study (AME 599, 699, 799) or research (AME 900) or case study (AME 908).</p> <p>9-12 units in the minor depending on the minor department requirement.</p> <p>*24-30 units may be transferred from the AME MS degree.</p>	<p><b>57</b> units of course work =</p> <p>3 units (semesters) of graduate seminars AME 696G **</p> <p>Minimum 36 units in area of major subject. Each student's transcript will be evaluated and, depending on background, a student may be required to take more than the minimum number of credits. Up to 30 units may be transferred from an MS degree, subject to Graduate College rules for credit transfer, and if they are appropriate for inclusion in the student's PhD Plan of Study.</p> <p>Maximum of 6 units of individual study (AME 599, 699,799) or research (AME 900) or case study (AME 908)</p> <p>9-12 units in the minor depending on the minor department requirement.</p>	<p><b>59</b> units of course work =</p> <p>5 units (semesters) of graduate seminars AME 696G**</p> <p>6 units AME 500A/500B</p> <p>Minimum 36 units in area of major subject. Each student's transcript will be evaluated and, depending on background, a student may be required to take more than the minimum number of credits. Core courses in preparation of Qualifying Exams may be included among these units.</p> <p>Maximum of 6 units of individual study (AME 599, 699,799) or research (AME 900) or case study (AME 908)</p> <p>9-12 units in the minor depending on the minor department requirement.</p>

\*\*Grades for AME 696 are granted based on participation and attendance.

## **2. Transfer Credit**

Up to 30 units may be transferred from a University of Arizona M.S. degree program, subject to Graduate College approval, and if they are appropriate for inclusion in the student's Ph.D. Plan of Study. Graduate work completed at another graduate-accredited institution may be transferred provided a grade of A or B was assigned for these enrollments. Students wishing to apply transfer coursework from other institutions to their graduate career must submit a Transfer Credit Form via GradPath (see <https://grad.arizona.edu/gcforms/academic-services-forms>). Please note that the transfer coursework should be submitted for evaluation before the end of the student's first year in residence, and that this evaluation serves as a preliminary approval process. The transfer coursework will not be applied to the student's AME program until pre-approved transfer coursework is approved by the department on the student's Doctoral Plan of Study form.

**Special Note:** AME students who have received credit for AME 4XX are not permitted to receive graduate credit for AME 5XX in a combined AME 4XX/5XX course. The only exceptions are the following design courses -- AME 520, 522, and 528 -- which offer considerable latitude for enriching the graduate-level design experience.

## **3. Qualifying Examination**

In order to continue their doctoral studies, all Ph.D. students are required to pass the Qualifying Examination. The intent of the Qualifying Examination is to evaluate the student's knowledge and understanding of the materials covered in the examination and to evaluate the student's potential to successfully complete a Ph.D. research program. Thus, while knowledge of the material and mathematical techniques covered in the individual examinations is important, the faculty look for much more than the ability to just memorize material. It is important that the candidate also have a good overall integrated understanding of the fundamentals of the material so that he/she can

- (1) properly relate the mathematical techniques and physical principles and apply these to engineering problems;
- (2) apply the material to a wide range of situations, including situations the student may not have previously seen; and
- (3) be able to demonstrate the ability to think about problems in a logical and appropriate manner.

**Please note that Ph.D. students are not eligible to register for dissertation units (AME 920) until the Qualifying Examination has been passed.**

### **3a. Deadlines for Completing the Qualifying Examination**

The deadline for taking the Qualifying Examination differs depending on the student's institution of study for their previous degree:

- Students who completed the requirements for the **M.S. degree with the University of Arizona** AME Department must take the Qualifying Examination no later than their second semester in residence for the Ph.D. degree (second semester of their first year).
- Students who completed the requirements for the **M.S. degree at another institution** must take the Qualifying Examination no later than their third semester in residence for the Ph.D. degree (first semester of their second year).

- Students who are on the **direct B.S. to Ph.D.** track must take the Qualifying Examination no later than their fifth semester in residence for the Ph.D. degree (first semester of their third year).

### ***3b. Qualifying Exam Structure and Policy***

Qualifying Examinations are given twice a year, starting Monday of the second week of classes in the Fall and Spring semesters. (Exceptions to this schedule may occur when the second week of classes for the semester falls on a scheduled holiday break.)

The written portions for the two subject areas will be administered as follows: **Engineering Mathematics on Monday and 1 subject on Tuesday.** If a student obtains a numerical score below 60 on the written examination, an oral exam must be scheduled for that subject area. **The oral portions of the exam, if needed, will be scheduled for Thursday and Friday.** For each area, the test consists of a closed-book, written portion of two hours' duration; the oral portion (if needed) is of one hour's duration. The written portion of the exam is administered to students in a group setting, whereas the oral exams are scheduled and administered individually.

An AME Faculty Meeting is generally called the following week to determine a Pass/Fail decision for each student. Each student is notified by mail as soon as possible after the results of the examinations are decided. In the event of failure, a second qualifying examination, on both subjects, is generally granted the following Semester. **No more than two attempts to pass this examination are permitted within AME**, even if the student transfers between Aerospace Engineering and Mechanical Engineering.

Each student must choose Engineering Mathematics and one other examination area. Material on the tests is at the Master's level. The Associate Department Head to the Graduate Program selects two examiners in each area responsible for preparing and grading the area exam.

The subject areas for the Qualifying Examination are:

**Engineering Mathematics**  
**Fluid Mechanics**  
**Kinematics and Dynamics**  
**Solid Mechanics**  
**Thermal Sciences**

Students planning to take the examination should obtain the booklet "Qualifying Examination Guidelines" from the Department Administrative Associate in Room N712. In this booklet, typical textbooks illustrating the topics covered and the level of the material are listed for each subject area.

### ***4. GradPath Doctoral Plan of Study***

Each student, in consultation with his/her major and minor advisors, should develop a plan of study that will satisfy the general requirements and be helpful in the student's dissertation work. The Doctoral Plan of Study should be completed **during the third semester of residence**



via GradPath (see <https://grad.arizona.edu/gcforms/academic-services-forms>). The Plan of Study describes the coursework you have completed and intend to complete toward the fulfillment of your degree for both the major and minor subject areas, sets your expected graduation date, and establishes your major advisor in UAccess.

Prior to submitting the Plan of Study, Ph.D. students must submit the **Responsible Conduct of Research Statement**; this form is the first in the series of GradPath forms to be completed by each student and must be completed before any other forms can be completed .

If you have previously submitted a Transfer Credit Form via GradPath, the Plan of Study form will allow you to submit these preapproved courses to your advisor for approval to be applied toward your graduate career. Please note that a course with a grade of “D” assigned cannot be submitted on the plan.

### **5. Oral Comprehensive Examination**

Before admission to candidacy for the Ph.D. degree, the student must pass the Oral Comprehensive Examination. This examination should be taken approximately one year after the Qualifying Examination, when the student has completed most of the coursework outlined in his/her Doctoral Plan of Study and has made a substantial start toward a dissertation. Normally, this would be during the fifth semester of study.

The Oral Comprehensive Examination is intended to test the student's knowledge in advanced subjects in the major/minor areas of study, as well as in the specialized dissertation area. It is the duty of the student's Ph.D. Advising Committee to conduct the comprehensive examination. The members of the student's Ph.D. Comprehensive Examination Committee shall meet to agree on the content, scope, format and schedule of the written and oral examinations. The committee will consider the student's performance on the Qualifying Examination and the scope of that examination in relation to the student's Doctoral Plan of Study.

#### **5a. Written Portion (Proposal) Structure and Pass Policy**

- i. **Major Area:** If the committee determines that sufficiently comprehensive knowledge has not been previously demonstrated in all areas of the Doctoral Plan of Study, the student will be provided with a list of the deficient areas together with a format for the written examination on them. Otherwise, the written portion of the exam for the major will consist only of the dissertation proposal, which is a requirement of all students.

The dissertation proposal is a properly prepared technical document which describes the proposed Ph.D. research. The requirements for the dissertation proposal are as follows:

- (1) It should consist of an abstract, introduction, description of proposed work, presentation and discussion of preliminary results, summary, and references.
- (2) The proposal should be prepared by the student with limited but critical guidance from the advisor. The advisor is not permitted to examine any version of the proposal prior to its submission, although general guidance may be given by the

- faculty. The student should realize that the proposal is also an important part of the Oral Comprehensive Examination. The purpose of the proposal is to indicate not only the academic preparation of the student, but also his/her ability to carry out original and creative research and to communicate this effectively in a professional manner. The proposal may be based on discussions between the student and the advisor, appropriate references, independent research, and other material such as books, course work, or input from faculty.
- (3) All secondhand information in the proposal (including private communications) must be clearly referenced, and the wording of the proposal must be that of the student.
  - (4) The proposal should be about 20 pages long, typewritten and double-spaced. Under no circumstances can a faculty member rewrite or modify any part of the proposal. Student and faculty must realize that the proposal is an independent contribution of the student, based on material absorbed from several sources.
- ii. **Minor Area:** Since the examination in the minor area is given by the minor Department, it is not possible to describe all the alternatives here. The student should check with his/her minor Department to learn the requirements of the examination.
  - iii. **Pass Policy:** The student passes the Written Comprehensive Examination if the proposal is deemed satisfactory and if the written comprehensive examination formulated by the Committee is passed. If the proposal is judged unsatisfactory for minor reasons, the student will be asked to revise it and resubmit it within two weeks. Only one revision is permitted. If the proposal is considered substandard (usually for technical reasons) it will be rejected outright and the student will be asked to reformulate his/her approach (perhaps even to change his/her topic) and to rewrite the proposal completely. A period of six months is given for resubmission in the latter case.

#### ***5b. Oral Portion of the Comprehensive Exam and Pass Policy***

Before the oral examination may be scheduled, the student must pass the written portions. The oral examination must be held no sooner than two weeks and no later than six months after the written examinations.

The Ph.D. Comprehensive Examination Committee consists of three faculty members from the major department and one from the minor. It is important to note that even if the minor Department waives participation of a Minor department faculty member, a fourth member from the AME Department must be approved by the Minor department to participate in the comprehensive exam committee and to cover material related to the Minor area. The fourth member may be tenured or tenure-track, or a special member.

- i. **Scheduling the Examination:** It is the responsibility of each student to arrange his/her oral comprehensive examination in a timely fashion. The following steps must be completed in preparation for the Oral Comprehensive Examination:
  - (1) Once the members of the Ph.D. Comprehensive Examination Committee have been selected (4 members, including the Major/dissertation advisor, two tenure/tenure track AME faculty members, and a tenure/tenure track faculty member to cover material from the student's Minor area), the student must submit the **Comp Exam Committee Appointment Form** in GradPath.

- (2) Schedule the comprehensive exam. In scheduling the comprehensive exam date and time, students must consider the availability of their committee members and the availability of the room and laptop projector (if needed) for their defense.
  - (3) Submit the **Announcement of Doctoral Comprehensive Exam** in GradPath at least two weeks prior to the requested examination date.
- ii. **Oral Comp Exam Structure:** The oral examination lasts at least one hour but not more than three. The oral examination begins with a 20-minute formal presentation (including visual aids) by the student on his/her proposed research. This presentation should not be interrupted by questions from the audience (the advisor is the moderator). The student's presentation is followed by questions on the proposed work and the research area. The student's presentation and subsequent questioning should take about 1 hour. For the remainder of the examination, the committee members shall ask questions of a more general and comprehensive nature. These questions may be based on course work, fundamentals relating to the student's area of research, or specific issues related to the proposal or the student's presentation.
  - iii. **Results of the Oral Comprehensive Examination:** Based on the student's combined performance in the written and oral portions, the examining committee awards the grade of Pass or Fail. The student's advisor submits the result of the student's Oral Comprehensive Exam to the Graduate College by submitting the GradPath form, **Results of Comprehensive Examination**. This form must be submitted to the Graduate College Degree Certification Office within 24 hours of the completion of the oral comprehensive exam. Once a student passes the oral comprehensive exam, the Graduate College will automatically advance students to candidacy and the candidacy fee, dissertation processing fee and the archiving fee will be billed to the student's account.

If the student fails, he/she must take the entire examination over at a later date, if so recommended by the examining committee. **No more than two attempts at this examination are permitted within AME, even if the student transfers between Aerospace Engineering and Mechanical Engineering.**

#### ***6. Prospectus/Proposal Confirmation***

Once the Oral Comp Exam Committee Chair has posted the results of the student's Comprehensive Exam in GradPath, the student must submit an approved copy (i.e., signed or initialed by the student's advisor) of his/her prospectus/proposal to the Department Administrative Associate, who will then place the copy in the student's file and submit the **Prospectus/Proposal Confirmation** form in GradPath.

#### ***7. AME 696G Seminar Presentation***

During the final year of study, each Ph.D. student must present a department seminar describing his/her research for AME 696G. This presentation is in addition to the course requirement of 3-5 units of credit in AME 696G. The student should arrange a class date for his/her seminar presentation with the Coordinator for the AME 696G seminars as early as possible in the semester and plan on giving a presentation roughly 45 minutes in length.

## **8. Final Oral Dissertation Defense and Graduation**

The final examination is an oral defense of the dissertation and may appropriately include any general questioning related to the field of study related to the dissertation. The presentation is open to the public. The examination should not exceed three hours.

### **8a. Enrollment Requirements**

All Ph.D. students must register each Fall and Spring semester for a minimum of 3 graduate units, until they have completed all course requirements, written and oral comprehensive exams, and 18 dissertation units. Once these requirements have been met, doctoral students not on financial assistance and/or needing to maintain appropriate visa status, may register for a minimum of 1 unit of dissertation credits in a Fall or Spring semester until final copies of the dissertation are submitted to the Graduate Student Academic Services Office. If only the defense is to be completed during a Summer or Winter term, after the student has completed the aforementioned requirements, the student will not be required to register.

**IMPORTANT NOTE: International students and students receiving funding** such as assistantships, fellowships, loans, grants, scholarships or traineeships may be required by their funding source to register for more than 1 unit to meet full-time status requirements, and should check with their program advisor regarding such requirements to ensure that they remain qualified for funding. Also, enrollment is required if the student needs library privileges in his/her final semester.

### **8b. Final Ph.D. Oral Examination/Defense and Graduation**

Once a student has completed all of the course requirements for his/her Ph.D. program and is ready to prepare for a final oral examination, the following steps must be completed:

1. At least 3 weeks **prior** to their final oral defense examination, Ph.D. students who are planning to graduate must submit the **Doctoral Dissertation Committee Appointment Form** in GradPath. Usually, the members of the existing advising committee are named to the oral defense examining committee.
2. **The scheduling of the final oral examination and the fulfillment of all requirements relating to this examination are the sole responsibility of the student.** In scheduling the defense date and time, students must consider:
  - a. the availability of their dissertation committee members;
  - b. that they must be able to submit a copy of their dissertation to the committee members 2 weeks prior to the date of their defense;
  - c. the availability of the room and laptop projector for their defense;
  - d. that they must allow ample time after their defense to complete all necessary revisions by the semester deadlines posted by the Graduate College (see <http://grad.arizona.edu/academics/degree-certification/deadlines-for-graduation>). Ph.D. candidates should make sure that their paper format is consistent with the Graduate College guidelines found at <http://grad.arizona.edu/degrecert/manuals>.

3. Once the date of the defense is set, the student should submit the **Announcement of Final Oral Defense** in GradPath **no later than 7 days prior to exam** and inform the Graduate Administrative Associate of the date, time, and place of the defense.
4. Following the defense, the committee chair will email the result of the examination (Pass, Pass with Revisions, or Fail) to the Graduate College and Administrative Associate.
  - a. If no major revisions are required, the Department Graduate Administrative Associate will complete a Change of K Grades form once the student has completed their final oral examination.
  - b. If major revisions are required, the above forms will not be submitted to the Graduate College until all revisions have been completed and a bound copy has been submitted to the Department. If the student's dissertation requires major revisions, the committee chair should include an expected date of completion of revisions on the email, and send **a second email to the Graduate College once the revisions have been completed**. If the Graduate College does not receive verification that all of the revisions have been completed from the advisor by the submission deadline for the semester, the student's expected graduation date will roll forward to the next semester.
5. At least one month prior to the end of the semester, the student should confirm the Expected Graduation Date with the Graduate Administrative Associate and the Graduate College. The student should also contact let the Business Manager know if he/she plans to walk in PreCommencement. Students planning to attend PreCommencement should submit a PowerPoint slide with a bio for the PreCommencement Ceremony, and purchase announcements/tickets as needed.
6. **Please note that the AME department requires all graduating Ph.D. students to submit a bound copy of their dissertation to the Department Administrative Associate for the AME department library.** The AME Department requires the navy blue leather bound copy of the dissertation. Students should check with their thesis advisor and committee members as to whether each will also require a bound copy. Samples of previously submitted bound dissertations may be found in the AME Room N711.
7. **All graduating Ph.D. students are required to submit an electronic version of their dissertation** to the Graduate College at <http://dissertations.umi.com/arizona>.

### **C. Minoring in Aerospace or Mechanical Engineering**

Students from other departments who propose to minor in Aerospace or Mechanical Engineering are required to take 12 units of minor course work (approved by their minor advisor) and maintain a 3.0 or higher in the minor. It is important to note that

- Effective Spring 2003, students minoring in AME no longer need to take the qualifying examination in their minor area.
- AME requires that at least one AME faculty member attend the Comprehensive Exam to cover material from the minor area.

## **APPENDIX A**

### **Application for Teaching Assistantship, Graderships, and GTS**



**APPENDIX B**

**AME GRADUATE STUDENT ADVISING-MENTORING FORM**



**AME GRADUATE STUDENT ADVISING-MENTORING FORM**  
*(for completion at beginning of both first and second semesters of study)*

**NAME:** \_\_\_\_\_ **Student ID #:** \_\_\_\_\_

**Admit Semester:** \_\_\_\_\_ **Current Program of Study (circle one):** ME-MS    ME-PHD    AE-MS    AE-PHD

**OPTION (M.S. Students only):** \_\_\_\_\_ Thesis    \_\_\_\_\_ Master's Report    \_\_\_\_\_ Coursework Only

Semester 1 Pending/Completed UA Graduate Coursework:

Type	Course Number	Semester	Number of Units	Grade
Required	Semester 1: AME 500 A			
Required	Semester 1: AME 696G			
MS Core or PHD Major Subject Area				
MS Core or PHD Major Subject Area				
MS Other or PHD Minor Area				
MS Other or PHD Minor Area				

**Advisor Signature:** \_\_\_\_\_ **Date:** \_\_\_\_\_

Semester 2 Pending/Completed UA Graduate Coursework:

Type	Course Number	Semester	Number of Units	Grade
Required	Semester 1: AME 500 A			
Required	Semester 1: AME 696G			
MS Core or PHD Major Subject Area				
MS Core or PHD Major Subject Area				
MS Other or PHD Minor Area				
MS Other or PHD Minor Area				

**Advisor Signature:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**APPENDIX C**

**M.S. AND PH.D. PROGRAM CHECKLISTS**

Year	Checklist – M.S.	✓	
		Sem 1	Sem 2
Year 1	Meet with advisor; update and submit <b>AME Graduate Student Advising-Mentoring Form</b> to Administrative Associate.		
	Complete two semesters of AME 696G.		
	Complete two semesters of AME 500 (500A/500B)		
	Complete core courses offered during first year.		
	For report or thesis track, identify research area and advisor.		
	Submit <b>GradPath - Responsible Conduct of Research Statement</b> .		
	Submit <b>GradPath - Transfer Credit Form</b> if you want coursework from other institutions to be applied to your program.		
	<b>Master's/Specialist Plan of Study</b> to be submitted online via GradPath.		
Year 2	Meet with graduate advisor and update Plan of Study, if necessary. Send all changes to the Graduate College.		
	Complete course requirements: Thesis - 26 units coursework + 6 units Thesis/Report 29 units coursework + 3 units Report/Coursework Only 32 units coursework:		
	- 6 units from AME 500A, 500B		
	- 2 units AME 696G		
	- 6 units Thesis or 3 units Master's Report		
	- 9 units Core Courses		
	- No more than 6 units non-AME Courses		
	Submit <b>GradPath - Master's/Specialist Committee Appointment Form</b> . <b>This form is required for students in all M.S. programs – Thesis, Master's Report, Coursework Only.</b>		
	Complete research and write-up of Thesis/Report.		
	Select examination committee and schedule your defense. The exam date should be early enough in the semester to complete revisions by Graduate College submission deadlines.		
	Give copy of Thesis/Report to Committee Members 2 weeks prior to defense.		
	Schedule room (and projector) for defense; provide date and time of defense to the Graduate Administrative Associate		
	After thesis/report defense, complete all revisions and submit bound copies to Department Graduate Administrative Associate and advisor/committee members.		
	Graduate Administrative Associate will submit Change of K Grades form (for Thesis/Research/Report courses) to Graduate College as well as notify Graduate College that you have completed your degree requirements.		
Make graduation plans: <ul style="list-style-type: none"> <li>- Let the Business Manager know if you plan to walk in PreCommencement;</li> <li>- Submit PowerPoint slide with bio;</li> <li>- Purchase announcements/tickets.</li> </ul>			

Year	Checklist – MS to PHD track	✓	
		Sem 1	Sem 2
Year 1	Meet with advisor; update and submit <b>AME Graduate Student Advising-Mentoring Form</b> to Administrative Associate.		
	Complete two semesters of AME 696G.		
	Identify dissertation area and advisor.		
	Submit <b>GradPath - Responsible Conduct of Research Statement</b> .		
	Submit <b>GradPath -Transfer Credit Form</b> if you want coursework from other institutions to be applied to your program.		
	<b>Ph.D. students who completed their M.S. previously at the University of Arizona should prepare for and pass the Qualifying Examinations in Semester 2.</b>		
Year 2	Submit <b>GradPath - Doctoral Plan of Study</b> .		
	Minor area courses.		
	Complete additional courses and 696G according to study plan.		
	<b>Ph.D. students who completed their M.S. elsewhere should prepare for and pass the Qualifying Examinations in Year 2, Semester 1.</b>		
	Begin doctoral research.		
Year 3	Complete all coursework (57 units):		
	- 3 units AME 696G		
	- U.A. MS: 12 units Major subject (24 units transferred from the AME MS degree.)		
	- Non-U.A. MS: 36 units Major subject		
	- Max 6 units of individual study (AME 599, 699, 799) or research (AME 900) or case study (AME 908)		
	- 9-12 units Minor area.		
	- 18 units Dissertation AME 920		
	Form comprehensive examination committee; submit <b>GradPath - Comp Exam Committee Appointment Form</b> .		
	Schedule comprehensive exam.		
	Submit <b>GradPath - Announcement of Doctoral Comprehensive Exam</b> .		
	Pass comprehensive examinations in major & minor areas; Committee Chair will submit <b>GradPath - Results of Comprehensive Examination</b> .		
Continue with research.			
Year 4	Select committee for final examination; submit <b>GradPath - Doctoral Dissertation Committee Appointment</b> .		
	Submit an approved dissertation prospectus/proposal (signed or initialed by your advisor) to the Graduate Administrative Associate.		
	Complete research.		
	Present dissertation research at AME 696G seminar.		
	Prepare dissertation.		
	Schedule room (and projector) for dissertation defense; provide date and time of defense to the Graduate Administrative Associate.		
	Submit <b>GradPath - Announcement of Final Oral Defense no later than 7 days prior to exam</b> .		
	After final oral exam, the Chair of your Oral Defense Examining Committee will submit <b>GradPath - Results of Final Oral Defense</b> .		
	After dissertation defense, complete all revisions and submit bound copies to Department Graduate Administrative Associate and advisor/committee members.		
	Graduate Administrative Associate will submit Change of K Grades form to Graduate College upon receipt of bound copy.		
	Make graduation plans:		
- Let the Business Manager know if you plan to walk in PreCommencement;			
- Submit PowerPoint slide with bio;			
- Purchase announcements/tickets.			

Year	Checklist – BS to PHD track	✓	
		Sem 1	Sem 2
Year 1	Meet with advisor; update and submit <b>AME Graduate Student Advising-Mentoring Form</b> to Administrative Associate.		
	Complete two semesters of AME 696G.		
	Complete two semesters of AME 500 (500A/500B)		
	Identify dissertation area and advisor.		
	Submit <b>GradPath - Responsible Conduct of Research Statement</b> .		
	Submit <b>GradPath - Transfer Credit Form</b> if you want coursework from other institutions to be applied to your program.		
Year 2	Submit <b>GradPath - Doctoral Plan of Study</b> .		
	Minor area courses.		
	Complete additional courses and two semesters of 696G.		
	<b>BS to PhD students should prepare to take Qualifying Examinations in Year 3, Semester 1.</b>		
	Begin doctoral research.		
Year 3	<b>BS to PhD students should pass the Qualifying Examinations in Year 2, Semester 1.</b>		
	Complete 1 more semester of AME 696G (to total 5 units).		
	Continue doctoral research.		
Year 4	Complete all coursework (59 units):		
	- 5 units AME 696G		
	- 36 units Major subject		
	- Max 6 units of individual study (AME 599, 699, 799) or research (AME 900) or case study (AME 908)		
	- 9-12 units Minor area.		
	- 18 units Dissertation AME 920		
	Form comprehensive examination committee; submit <b>GradPath - Comp Exam Committee Appointment Form</b> .		
	Schedule comprehensive exam.		
	Submit <b>GradPath - Announcement of Doctoral Comprehensive Exam</b> .		
	Pass comprehensive exams in major & minor areas; Committee Chair will submit <b>GradPath - Results of Comprehensive Examination</b> .		
Continue with research.			
Year 5	Select committee for final examination; submit <b>GradPath - Doctoral Dissertation Committee Appointment</b> .		
	Submit an approved dissertation prospectus/proposal (signed or initialed by your advisor) to the Graduate Administrative Associate.		
	Complete research.		
	Present dissertation research at AME 696G seminar.		
	Prepare dissertation.		
	Schedule room (and projector) for dissertation defense; provide date and time of defense to the Graduate Administrative Associate.		
	Submit <b>GradPath - Announcement of Final Oral Defense no later than 7 days prior to exam</b> .		
	After final oral exam, the Chair of your Oral Defense Examining Committee will submit <b>GradPath - Results of Final Oral Defense</b> .		
	After dissertation defense, complete all revisions and submit bound copies to Department Graduate Administrative Associate and advisor/committee members.		
	Graduate Administrative Associate will submit Change of K Grades form to Graduate College upon receipt of bound copy.		
	Make graduation plans:		
- Let the Business Manager know if you plan to walk in PreCommencement;			
- Submit PowerPoint slide with bio;			
- Purchase announcements/tickets.			

