

HANDBOOK
FOR THE

MASTER OF ENGINEERING
IN ROBOTICS AND AUTOMATION
PROGRAM

IN THE

COLLEGE OF ENGINEERING

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I. INTRODUCTION

This handbook is prepared for the benefit of graduate students in the Master of Engineering in Robotics and Automation program. 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 this graduate program.

The Master of Engineering (MEng) in Robotics and Automation is our professional graduate program that consists of high-level, fast-paced coursework and significant engagement with industry-driven engineering projects. It prepares our graduates for a professional career path, or further graduate studies at UA or elsewhere.

In comparison to Master of Science, this professional degree emphasizes skills and practical analysis over the former's theory and research. Students interested in Master of Engineering in Robotics and Automation will have an opportunity to focus their study on autonomous systems, vehicles, or internet-of-things (IoT) devices. In addition to courses in control systems design and automation technology, the program provides essential training in engineering and business management (ENGR/SIE 514 and ENGR/SIE 514), which is not a requirement of the Master of Science degree.

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/>) and are not repeated here. Students are urged to become familiar with all the regulations governing degree requirements (<http://grad.arizona.edu/gsas>), as **it is the student's responsibility to discuss these requirements with their advisor or with the director of the MEng program and ensure that all of these requirements are satisfied at graduation.**

The Master of Engineering in Robotics and Automation program is administered by the Master of Engineering Steering Committee (MESC), 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 Coordinator, who will submit the issue for discussion by the Master of Engineering Steering Committee.

II. ADMISSION

A. General Admission Requirements

Admission to the Master of Engineering in Robotics and Automation program is based on a holistic evaluation of applicants' credentials, including undergraduate and/or graduate GPA, 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) 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 (or their sponsor's) cost 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.

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 the MEng 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 Director of the Master of Engineering Program; however, concurrent enrollment in two or more Ph.D. programs is not permitted.

B. Applying for Admission

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

- (1) two 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) 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 must apply and submit an online application for admission

- **by June 1st for Fall admission and**
- **by September 15th for Spring admission.**

See the next section of this Handbook, "Financial Aid" for additional information regarding departmental funding.

International applicants in particular must apply by the above deadlines in order to allow sufficient time for evaluation of applications before the following Graduate College deadlines for processing I-20 or DS-2019:

- Fall admissions I-20 or DS-2019 document issuing deadline is **June 15th**
- Spring admissions I-20 or DS-2019 document issuing deadline is **November 1st**

IMPORTANT: Once admitted all new international graduate and professional students have to complete 4 online check-in requirements. A hold will block class registration until you have completed the requirements. The hold will be removed within 2 business days of completing these 4 items:

- Immigration tutorial (<https://global.arizona.edu/international-students/pre-arrival-tutorials>)
- Cultural Adjustment tutorial (<https://global.arizona.edu/international-students/pre-arrival-tutorials>)
- New Student Information e-forms in UA International
<https://uainternational.arizona.edu/istart/controllers/start/start.cfm>
- Document Review e-forms in UA International (cannot be completed until after you have entered the United States.)
<https://uainternational.arizona.edu/istart/controllers/start/start.cfm>
 - Additional information regarding International Graduate students can be found at the International Student Services website
(<https://global.arizona.edu/international-students/graduate-students>)

III. FINANCIAL AID

A. Types of Funding

Applicants to the Master of Engineering in Robotics and Automation program may be eligible for departmental funding in the form of 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), as well as 50% registration remission/waiver of resident tuition, 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 covers 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.

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 June 1st for Fall admission and by September 15th for Spring admission**). Applicants are eligible for departmental funding consideration only after having received an offer of admission from the Graduate College.

Financial aid is awarded on a merit basis. Students' academic background is considered when evaluating applicants.

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

Once the department has approved funding for a student and he/she 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 Master of Engineering in Robotics and Automation program who receive funding from 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 9 units of credit each semester.
- (2) All graduate students, regardless of funding source or status, are **required to cover their own program and/or course fees, mandatory fees and any tuition not covered by their employment, fellowship, or scholarship**. Please note that failure to cover any or all of these expenses may result in significant late fees.

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) 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 at <http://grad.arizona.edu/financialresources/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.

IV. MEng DEGREE REQUIREMENTS AND PROCEDURES

The Master of Engineering in Robotics and Automation degree requires the completion of a total of 30 hours of coursework. Students can transfer up to 12 student credit-hours of equivalent graduate coursework completed at other institutions in order to satisfy some of the required courses.

A. Requirements to meet 40% COMMONALITY ACROSS ALL MENG SUBPLANS:

Students in all subplans of the MEng degree (including the Robotics and Automation subplan) must choose courses from the following **required 4 core areas (12 units)**, which constitute the required common 40% of the coursework for all MEng subplans:

- (1) To satisfy the **Applied Engineering/Mathematics requirement**, MEng students must complete:
 - AME 500A: Advanced Engineering Analysis (3 SCH)
- (2) To satisfy the **Engineering Management/Business requirement**, MEng students must **choose one** of the following courses:
 - ENGR/SIE 514: Law for Engineers/Scientists (3 SCH) or
 - ENGR/SIE 567: Financial Modeling for Innovation (3 SCH) or
 - SIE/MNE 503: Technical Leadership for Engineers (3 SCH)
- (3) To satisfy the **Innovation/Design requirement**, MEng students must complete:
 - AME 587: Design of Mechatronic Systems (3 SCH)
- (4) To satisfy the **Advanced Engineering Science requirement**, MEng students must complete:
 - a. AME 558: Introduction to Advanced Control Theory (Modern Control) (3 SCH)

B. Additional Courses Specific to the MEng in Robotics and Automation Subplan:

Students in the Robotics and Automation subplan of the MEng degree must complete the following **4 courses (12 units)**:

- AME 551: Introductory Robotics: Kinematics, Dynamics, and Path Planning (3 SCH)
- AME TBD: Programming of Real-Time Mechatronic Systems (3 SCH)
- AME 556: Non-linear and Optimal Control (3 SCH)
- AME 555: Introduction to System Identification Methods (3 SCH)

C. Additional Courses Specific to the MEng in Robotics and Automation Subplan:

Students in the Robotics and Automation subplan of the MEng degree must select two courses at minimum to meet 6 unit elective requirement (**6 units**):

- AME 596: Special Topics (Machine Learning) (3 SCH)
- AME 562: Composite Materials (3 SCH)
- SIE 555: Sensor System Engineering (3 SCH)
- ECE 554: Electronics Packaging Principles (3 SCH)

- AME 550: Advanced Dynamics (3 SCH)
- AME/ECE/SIE/MNE 909: Master's Report (up to 6 SCH)

D. Required GradPath Forms

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

- (1) **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.
- (2) **Transfer Credit Form:** Students wishing to apply transfer coursework from other institutions to their graduate career must submit a Transfer Credit Form via GradPath. 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 from the Graduate College. Please note that a course with a grade of "D" assigned cannot be submitted on the plan.
- (3) **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.
 - **Master's Specialist Committee Appointment Form.** This form is required for students in all Masters' programs! The Committee Appointment Form must be submitted in the semester in which you plan to graduate.
 - For students completing a **coursework-only degree**, there is no committee; these students should elect 'no' to having a master's committee and then list their advisor. It is important that an advisor is listed. This form is submitted electronically to the Graduate Coordinator for approval and then forwarded to the Graduate College.
 - Students who are **completing a Master's Report** should provide information about the committee members and expected graduation date, as well as listing their advisor.

The Master's Specialist Committee Appointment Form is the last GradPath form MEng students must complete; once this form is complete, they have met all of the qualifications for graduation.

Steps to Graduation

1. Confirming Your Expected Graduation

Once the Master's Specialist Committee Appointment Form has been submitted in GradPath, graduating students must:

- Confirm the Expected Graduation Date with the Graduate Administrative Associate and the Graduate College.

- Let the Business Manager know if he/she plans 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 MEng 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>.

Specifically:

- **Fall or Spring Semester Graduation for MEng students completing a coursework-only degree:** Students who are planning to graduate in a Fall or Spring semester must be registered for that semester for a **minimum of 3 graduate units** from original matriculation until all course requirements are met.
- **Fall or Spring Semester Graduation for MEng students who are completing a Master's Report:** Students who have met all course requirements and who are not on financial assistance or needing to maintain appropriate visa status must register for a **minimum of 1 unit** of AME 909 Master's Report credit each semester until the Report is finalized.
- **For Summer or Winter Term Graduation:** MEng students who are planning to complete their coursework or defend their report and graduate in a summer term 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

For students who have completed a coursework only MEng program, no final oral examination is required.

For MEng students who have completed a Master's Report, 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.

Once a student has completed all of the course requirements for his/her program and is ready to prepare for a final 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 committee members. The committee must consist of **three members**, of which at least two must be current tenure/tenure-track UA faculty members from the AME Department.
 - b. a copy of the Report must be submitted to the Committee members 2 weeks prior to the date of the defense. It is imperative that the format of the report be consistent with

Graduate College guidelines (see <http://grad.arizona.edu/degrecert/manuals>). In addition, copies of completed Reports may be found in the AME Room N711.

- 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 electronic submission of the final Master's Report 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. Following the defense, the 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.
4. **Please note that a bound copy must be 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 advisor and committee members as to whether each will also require a bound copy.
5. 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 at a defense, the student's committee will determine the steps that the student must complete before a second examination may be scheduled. Upon recommendation of the MEng Steering Committee, 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.