



COLLEGE OF AGRICULTURE & LIFE SCIENCES
COLLEGE OF ENGINEERING

Agricultural &
Biosystems Engineering

AGRICULTURAL AND BIOSYSTEMS ENGINEERING

Graduate Program Manual



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AGRICULTURAL & BIOSYSTEMS ENGINEERING MISSION, PURPOSE, VISION, VALUES

Mission

Our mission is to improve the quality of life in the Southwest through excellence in instruction, research, and extension programs. To achieve this, ABE will provide technologies and information systems for safe and secure food, water, energy, and biological products to adapt to a changing world.

Purpose

ABE develops and facilitates use of innovative technologies for generation of food, bioenergy, and bioproducts, with smart utilization of water, resources, and information, suitable for arid and semi-arid environments. Our faculty, staff, and students work across interfaces between science and engineering.

Vision

ABE will be a world leader known for developing technologies and systems for the safe production of food, bioenergy, bioproducts, and biological information for sustainable use of arid and semi-arid environments. Students, constituents, and professionals will come from across the world to participate with our programs.

Shared Values

Excellence

Faculty, staff, and students will have academic freedom and our research and educational programs will be of the highest quality.

Openness

We will communicate openly and treat people fairly because we value the opinions and respect the needs of all.

Ethics

High ethical standards and sound decision-making will be at the heart of our business and financial practices.

Diversity

Diverse people, ideas, backgrounds and perspectives produce lasting solutions. We will make it our duty to encourage and help all to be successful.

Cooperation

We will forge partnerships on and off campus in our drive to solve society's complex problems and improve the quality of life.

1.0 INTRODUCTION

The purpose of this handbook is to provide students with information on the requirements and procedures for pursuing a graduate degree (MS, AMP, or PhD) in the Department of Agricultural and Biosystems Engineering (ABE) at The University of Arizona. The Department is active in research in the general emphasis areas of Biometry and Biosystems Informatics; Controlled Environment Agriculture; Food, Bioproducts, and Renewable Energy; and Water Resources. However, students will find that a graduate program in the ABE department can be designed to fit almost any need in the general field of the application of engineering principles to the solution of agricultural and biological engineering problems. The flexibility of the program allows foreign and domestic students, in consultation with their advisors, to develop programs specifically suited to their needs. The University of Arizona is a diverse institution, and therefore provides courses in many different areas to support specific and general programs.

This handbook is a compilation of current policies, practices, and procedures of the Graduate School and the Department of Agricultural and Biosystems Engineering. Information found in the Graduate catalog, which the student is expected to be familiar with, is to be used as the basis for the resolution of any special problems, the treatment of any extraordinary conditions, and the source for details not covered by this handbook. In some instances, requirements differ between the Graduate College handbook and this document. In these instances, the departmental requirements supersede Graduate College requirements. If a topic is not covered in this handbook, the Graduate College regulations will be enforced. The requirements listed herein are effective from the handbook publication date.

Contained in this handbook are general program information, admission requirements, general administration of the graduate program, and deadlines for the submission to the Graduate College of items such as study programs, reports on examinations, etc. The Graduate College publishes official specific deadline dates. A copy of official deadline dates can be obtained from the ABE Academic Advisor or the Graduate College website (<http://grad.arizona.edu/>).

2.0 DEGREE PROGRAM INFORMATION

The Department offers the following degrees in Agricultural and Biosystems Engineering: Master of Science (MS), Accelerated Master of Science (AMP), and the Doctor of Philosophy (PhD). There are two options in both the MS and AMP degrees (i) thesis and (ii) report. The thesis option (MS/AMP) is intended for students who want to study in a specialized area and to work closely with a faculty member on a unique research topic. The report option is intended for students desiring a broad education and engineering practice and it is comprised of coursework in several areas, and an engineering report done under the supervision the student's major professor and the student's committee members.

3.0 ADMISSION

3.1 General Admission Requirements

All Candidates must apply on line through the Graduate College application site located at: <https://apply.grad.arizona.edu/users/login>. Graduate Admission Requirements are at: <https://grad.arizona.edu/prospective-students> . The application for admission includes official transcripts from all previous colleges and universities attended, resume (CV), scores from the Graduate Records Examination (GRE), three letters of recommendation, and the applicant's statement of purpose.

A departmental review committee made up of faculty from the student's area of interest evaluates the candidates' application. Applicants are evaluated on the individual merits of their academic achievements and scholarly potential to complete graduate level coursework and research requirements. Once the decision is made the departmental recommendation will be transmitted to the Graduate College, and the candidate will be notified of the decision.

To be considered for the MS program, the candidates must hold a Bachelor's degree. To be considered for the PhD program the candidate must hold a BS and/or MS degree. Candidates with degrees from non-engineering programs will be required to take additional engineering undergraduate courses to overcome deficiencies.

For more details on the admission process please see:

<http://grad.arizona.edu/admissions/requirements>.

3.2 Requirements for International Candidates

In addition to the academic requirements for all applicants, international students must satisfy English proficiency, financial guarantee, and health insurance requirements. To demonstrate proficiency in English, a minimum score of 550 (or a computer-based score of 213) on the Test of English as a Foreign Language (TOEFL) is required for all applicants whose native language is not English. The 550 score (or a computer-based score of 213) is a Graduate College requirement and cannot be waived. The Educational Testing Service should send an official report to The University of Arizona (institution code is 4832).

For more information on the additional requirements for international candidates/students please refer to: <https://grad.arizona.edu/international-students>.

3.3 Summary of Admission Requirements

Qualified candidates must meet the minimum criteria to qualify for the ABE Graduate Programs:

GPA: MS 3.0; PhD 3.3

GRE: Quantitative minimum 151, Verbal minimum 138, Analytical minimum 3.0.

Intentional language test requirements

Test TOEFL: IBT– 79; CBT - 213R; PBT- 550

IELTS: *minimum composite score of 7 (no subject below 6)*

3.4 Removal of Deficiencies

To remove deficiencies candidates with deficiencies identified in the recommendation letter from the department head must complete the required course work satisfactorily, prior to completing graduate degree program.

If a student disagrees with the written statement of deficiencies given at the time of admission, he/she should contact the Academic Program Coordinator to a file petition to request for a review of the deficiencies and previous course work completed.

4.0 FINANCIAL SUPPORT IN THE ABE DEPARTMENT

Although there is no guarantee of funding for pursuing a graduate degree, there are several options available to graduate students.

4.1 Graduate Research and Teaching Assistantships

Depending on funding allocations, Research Assistantships (RAs) and Teaching Assistantships (TAs) may be available. Department policy provides that MS students will be supported for no more than four (4) semesters (2 years) and PhD students for no more than eight (8) semesters (4 years). The non-resident tuition fee is waived for students on assistantships of 25% time or more; the registration fee is *not* waived. There is a tuition remission of 50% or more of the registration fee depending on the level of appointment (0.25, 0.33, or 0.50). Graduate assistants on half-time assistantships are expected to work 20 hours per week.

4.1.1 Research Assistantships (RAs)

Research Assistantships (RAs) are provided by individual faculty member's research grants. These faculty members are responsible for identifying students to work on these projects.

4.1.2 Teaching Assistantships (TAs)

Students hired on Teaching Assistantships need to review policies, and complete training and orientations required by the Graduate College (see <https://grad.arizona.edu/funding/ga>).

4.2 Graduate College Theses/Dissertation Scholarship

International students who have completed their coursework and are within 2 years of completing their PhD degree or 2 semesters of completing their MS degree may qualify for this Scholarship. This award *excludes* the mandatory registration fees and any additional tuition charged by the individual programs. Students who are hired on appointment as a Research Assistant do not qualify for this waiver.

To be *eligible for a Graduate College Theses/Dissertation scholarship*, students must be enrolled at the University of Arizona for not less than one (1) and not more than six (6) units of 910/909/920 level units only. Generally, waivers for students enrolling in 1 unit will be approved. Students must have met all course and unit requirements and be finishing up his/her Thesis/Dissertation.

International students who qualify should request for scholarship through the ABE Academic Program Coordinator at least two months prior to the beginning of the semester that they are eligible to apply for the scholarship. For more information on this scholarship, see <https://grad.arizona.edu/funding/opportunities/thesis-dissertation-tuition-scholarships>.

4.3 Hourly Graders

The ABE Department often has hourly grader positions available.

5.0 GENERAL ADMINISTRATION OF THE GRADUATE PROGRAM

5.1 Orientations

Most semesters Orientations are conducted for graduate students by the department's Director of Graduate Studies and the Academic Program Coordinator. New students and students who are hired as Graduate Assistants are required to attend all of the Graduate College orientations locations and times will be posted each year on the following site: <https://grad.arizona.edu/> announcements.

5.2 Registration

Registration is accomplished using the UAccess, the University's web-based course registration program, <http://www.uaccess.arizona.edu/>. Registration for the first semester in residence should be completed after meeting with the Director of Graduate Studies and the Academic Program Coordinator.

5.3 Deficiencies

To remove deficiencies students with deficiencies identified in the recommendation letter from the department head must complete the required course work satisfactorily, prior to completing graduate degree program.

5.4 Continuous Enrollment Policy for Domestic Students

To be considered full-time, domestic graduate students need to enroll in 3 units per semester. If you are unable to enroll in fall or spring semester, to maintain your student status, you should submit a Leave of Absence. If you fail to meet the continuous enrollment policy and do not register,

you will need to reapply to the Graduate College and be approved for readmissions by the Associate Dean of Academic Programs.

5.4.1 Summer Enrollment

MS students who are graduating in summer are required to enroll during Summer Session II. PhD students who have completed their course work and are graduating in summer do not need to enroll in a summer Session.

5.4.2 International Students

International students need to follow his or her individual visa enrollments requirements, for more information regarding University of Arizona's policy for international graduate student enrollment policies, see <https://global.arizona.edu/international-students>.

5.4.3 Graduate Assistantships

Students who are supported by or through The University of Arizona, via assistantships as a Graduate Assistant in Teaching (GAT) or Graduate Assistant in Research (GAR) are expected to officially enroll in at least nine 9 units per semester. Individual Colleges may set their own GAT/GAR enrollment requirements. For more information on enrollment requirements for students on assistantships, see <https://grad.arizona.edu/funding/ga>.

Graduate students hired on an assistantship through the College of Agriculture & Life Sciences must be enrolled in at least 10 units, per college requirements.

5.4.4 Graduate Scholarships

Students who have been awarded Graduate Registration Scholarships or Graduate Tuition Scholarships are required to be enrolled as a full time student per Graduate College policies. For more information, see <http://grad.arizona.edu/funding/opportunities>.

5.5 Major Professor

The Academic Program Coordinator will serve as the Administrative Advisor. The Administrative Advisor will assist the candidate with all graduate forms, entering information into GradPath, checking procedures, and other administrative activities.

In the first few weeks after joining the program, students should meet with the ABE Director of Graduate Studies to discuss options and procedures for choosing a Major Professor. A permanent

Major Professor must be chosen by the end of the first semester of study. The candidate's Major Professor should specialize in the student's main field of interest. The primary role of the Major Professor is to guide the student in coursework and to keep the student informed on whether he/she is making satisfactory progress. The Major Professor will act as the student's mentor, be responsible for *helping* the student select his/her MS/PhD Committee members, and serve as the Thesis/Report Committee chair as well as developing and completing a Plan of Study in collaboration with the Thesis/Report Committee. The Major Professor is responsible for meeting with the student a minimum of once per semester to review the student's progress.

5.6 Graduate Committee Meetings

The student are expected to meet with his/her committee members at least once a semester. The purpose of the meeting is to have the overall committee review the academic progress of the candidate.

5.7 Leave of Absence Policy

It is not necessary for a student to apply for a Leave of Absence (LOA) if he or she has a registration record for that semester. A "W" counts as a registration record. An LOA is inappropriate for a student who withdraws from all classes after the start of a semester and gets "W" grades since a Leave of Absence presupposes no registration at all for a term. Since, in such cases, the student has maintained continuous enrollment by having a registration record, he or she is eligible to register the following semester (or Summer or Winter term) and will suffer no adverse effects due to the fact that he or she was not eligible to apply formally for a Leave. Only academic services or facilities available to the general public can be used during the LOA. An LOA may affect the status of a graduate student's financial aid. Students are responsible for determining the requirements of their funding agency and/or academic unit prior to applying for a Leave of Absence.

International students must check with the International Students Programs and Services before filing for a Leave of Absence.

If a student fails to register and does not have a Leave of Absence on file, the student will be discontinued from their program. A new application will be necessary for the student to continue in the program. Re-admission is not guaranteed. See Continuous Enrollment and Re-admission Policies for more information.

More information may be found at: <http://grad.arizona.edu/policies/enrollment-policies/leave-absence>.

5.8 Enrollment in ABE 696A

5.8.1 ABE 696A-001

MS, AMP, and PhD students are required to enroll in 696A-001, each semester if they are not presenting.

5.8.2 ABE 696A-002

MS and AMP students and PhD students who received an ABE MS degree are required to enroll in **ABE696A-002** and make 2 presentations to earn 2 units of seminar that will count towards their degree. PhD students who did not receive an ABE MS degree, are required to enroll in ABE 696A-002 and make **4 presentations** to earn 4 units towards their degree. Students who have proof that they have made a presentation in another institution, may petition and receive a waiver for the number of units required.

5.8.3 International Students on a Thesis/Dissertation Scholarship Award

International students on a Thesis or Dissertation Scholarship Award are waived from the enrollment requirement for 696A. However, these students are required to attend the course and meet all other requirements.

5.9 UAccess GradPath

Graduate Students are required to use GradPath located in the UAccess Student system, <http://uaccess.arizona.edu/>, to complete their Graduate College degree certification forms. GradPath can be found by selecting the drop down box located on the Academics section in UAccess. Once the student completes the required form in GradPath, the form automatically routes to everyone who needs to see or approve the form. If you need assistance with this process please contact your Academic Program Coordinator.

5.10 UAccess GradPath Forms

Each of the following steps requires completion and should be taken at the appropriate time during the student's tenure at the department. To keep on schedule for graduation, please refer to the dates and deadlines posted on <http://grad.arizona.edu/gsas/degree-requirements/important-degree->

[dates-and-deadlines](#). The appropriate student forms may be accessed through UAccess, <http://uaccess.arizona.edu/>.

5.10.1 Responsible Conduct of Research Statement

This is the first form to complete in order to go forward in GradPath. The next in GradPath form cannot be opened until this the Responsible Conduction of Research Statement section is completed.

5.10.2 Plan of Study (POS) Form

In conjunction with his/her major professor, each student is responsible for developing a Plan of Study (POS) during his/her first year in residence. ABE students are required to submit their POS in GradPath by the end of their 1st semester in the program. For further information on the POS, MS students should see section 6.4 and the PhD students should see section 7.8. Prior to creating the POS students should read the Graduate College's requirements at <http://grad.arizona.edu/gsas/degree-requirements>.

5.10.3 Committee Appointment Form

Students should complete their Committee Appointment Form in GradPath no later than the last day of class during their second semester. Students will be required to enter their Committee Members, expected graduation term and year, title of their Thesis/Dissertation. For more information on submitting and archiving your thesis/dissertation, please refer to <https://grad.arizona.edu/gsas/degree-requirements/masters-degrees#thesis-committee>.

5.10.4 Degree (MS, AMP, PhD) Completion Form

This GradPath form is completed by the Academic Program Coordinator after receiving the results of the Final Oral Defense (Examination) from the Major Professor (Committee Chair). For more information, please refer to <http://grad.arizona.edu/gsas/degree-requirements>.

5.11 Graduate Student Academic Progress Reports

All ABE graduate students are required to submit a Graduate Student Academic Progress Report (GSAPR) once in an academic year either by April 15 during the spring semester or November 15 during the fall semester.

5.12 Change of Degree Program

MS student who wish to apply to the PhD program after completing their MS degree are welcome to do so. To change their degree objective from ABE Master's to ABE PhD they can file a Change of Degree form at any time they are in the program. Interested students should contact the ABE the Academic Program Coordinator as well as complete the on-line application for the ABE PhD Program. For more information on the UA's policy on change of degree, please visit: https://grad.arizona.edu/forms/sites/default/files/uagc_page/changeofprogramform.pdf.

The Official Transcript requirement is waived for students who graduated with a BS and/or MS from the University of Arizona. Students will be required to complete a PhD application for the program and are required to upload an unofficial copy of their UA transcripts into the PhD application.

5.13 Thesis/Dissertation Publication Requirements

All MS thesis option and PhD candidates are required to submit papers or receive committee approval meeting the standard for publication in a refereed scientific or engineering journal by the time of their Final Oral Defense. Details about the Thesis and Dissertation paper submission requirements and forms can be found in Appendix B.

5.14 Archiving Thesis and Dissertation

A student who is completing a thesis/dissertation (with enrollment in course number 910 & 920) is required to archive her/his thesis/dissertation upon final approval of his/her graduate committee. The thesis/dissertation will be added to the University of Arizona Campus Repository and to the national archive of thesis/dissertations and maintained by ProQues/UMI. There is no charge to the student for archiving the thesis/dissertations. The thesis/dissertation must have been successfully defended and approved by the candidate's committee with all final edits completed in time for the student to submit it online for archiving by the graduation deadline for the student's graduation term.

5.15 Commencement

The University of Arizona, the Colleges of Agriculture and Life Sciences and Engineering, and the Department of Agricultural and Biosystems Engineering all celebrate graduate degree completion.

5.15.1 University Commencement

The University of Arizona holds their commencement once a year in May. UA Commencement information can be found at <http://grad.arizona.edu/gsas/commencement>. The diploma will be mailed to the address you have listed on UAccess student link as your 'permanent' address. If you do not want it sent to your 'permanent' address you should create a 'diploma' address and it will be mailed there instead.

5.15.2 College of Agriculture & Life Sciences

The College of Agriculture and Life Sciences has hooding ceremonies twice a year, at the end of each academic semester. Graduate students have the option of attending this ceremony. Graduate students will be expected to select a Faculty Member to perform the Hooding ceremony.

5.15.3 College of Engineering

The College of Engineering holds a commencement/hooding ceremony at the end of the fall semester. Graduate students have the option of attending both this ceremony and the CALS hooding ceremony. Graduate students will be expected to select a Faculty Member to perform the Hooding ceremony.

5.15.4 Agricultural & Biosystems Engineering Department

The ABE department holds a pre-commencement reception/dinner twice a year--at the end of each academic semester. Students completing degree requirements in August have the option of attending either the May or December pre-commencement events. Students not completing all graduation requirements, but are close may attend one pre-commencement reception/dinner of their choosing.

5.16 International Student Resources

International student should familiarize themselves with the Office of Global Initiatives for International Students (see <http://global.arizona.edu/>) as well as review the Student Resource Manual at <http://global.arizona.edu/international-students/student-resource-manual>.

Please check with the Office of International Student Programs to be sure you are in compliance with your visa status obligation, since you may be required to be enrolled in additional units to maintain your full-time student status. You should also check your I-20 expiration date and if necessary begin the renewal process giving yourself plenty of time to maintain your status. The process may take up to 6 months or more.

5.17 Graduate Student Learning Outcomes Assessment

5.17.1. Expected Learning Outcomes

By completion of the Graduate programs (MS Thesis/MS Engineering Report/PhD) in Agricultural and Biosystems Engineering, a student will:

1. demonstrate broad knowledge of the his/her focus area in ABE,
2. critically analyze published research results in his/her focus area in ABE,
3. conduct original research on a significant ABE problem, and
4. effectively communicate and defend results of research to peers and broader scientific audiences.

5.17.2. Assessment Activity

Assessments will be conducted throughout the graduate student's tenure in the ABE Department as shown in Table 1. Common to all graduate programs in the ABE department are the requirements of graduate seminar presentations and the oral and written defense of the research or creative activity. In addition to these common elements, the ABE PhD program requires a student to complete a written and oral comprehensive exam based upon coursework and the student's focus area. These already-existing assessment activities are also used to gather program level assessment data. Appendix F has all the rubrics for assessments in Table X.

Table 1. Graduate program assessments.

Assessment Activities	Outcome 1: Knowledge of the Focus Area	Outcome 2: Critical Analysis of Research in the Focus Area	Outcome 3: Conduct Original Research	Outcome 4: Communicate and/or Defend Research
Graduate Seminar Presentations ¹	X	X		X
Written Comprehensive Exams ²	X			
Oral Comprehensive Exams ²	X	X		
Written Dissertation & Oral Defense of the Dissertation ¹		X	X	
Exit Survey ¹	X	X	X	
¹ For example of rubrics, see Appendix F				
² For example of rubrics, see Appendix E				

6.0 Master of Science (MS) Degree in Agricultural & Biosystems Engineering

This section summarizes the requirements and steps for completing a master's degree. MS students are responsible for knowing the ABE program and Graduate College requirements. MS students also need to review through the Graduate College Policies and Procedures located at <http://grad.arizona.edu/policies> and the degree requirements for Master's degrees located at <http://grad.arizona.edu/academics/program-requirements/masters-degrees>. The requirements for Master's Degrees on the Graduate College website (<http://grad.arizona.edu/gsas/degree-requirements>) provides additional details. There are two MS program options: MS Thesis and MS Report. The checklist for completing the steps towards a master's degree is located in Appendix C.

6.1 Credit Requirements

All coursework must be in courses graded A, B, or C except for one independent study course. To complete degree requirements, the cumulative GPA in graduate level courses must be 3.0. A student whose GPA falls below 3.0 will not be permitted to register for additional courses. See Graduate College Policies online at <http://grad.arizona.edu/Catalog/Policies/>.

6.1.1 Minimum Course Requirements

30 units minimum consisting of the following:

1. 3 units STAT 571B
2. 3 units either Statistics (different than STAT 571B), Numerical Analysis, or a Mathematics/Modeling course
3. 16 units of ABE courses, including:
 - a. 2 units of ABE 501
 - b. 2 units of ABE 696A-002 (students who are presenting)
4. 5 units of either ABE 910 Thesis (thesis option) or ABE 909 Engineering Report (non-thesis option) under his/her Major Professor's section number
5. 3 units of an Elective course (per Major Professor's approval)
6. ABE 696A-001 for each semester that candidate is not presenting. Students must receive approval from the Department to be excused from this requirement.

6.2 Time Limitation

All requirements for the master's degree must be completed within six (6) years. Time-to-degree begins with the earliest course to be applied toward the degree, including credits transferred from other institutions. Coursework more than six (6) years old is not accepted toward meeting degree requirements: <http://grad.arizona.edu/gsas/degree-requirements/masters-degrees#time-limitation>.

6.3 Transfer Credit

Transfer credits may apply towards the ABE MS degree. Students who wish to have Transfer units apply towards their ABE degree need to file a petition with the Academic Program Coordinator. The Graduate Program Committee will review the petition and determine if the transfer course is equivalent. If approval is granted, the course may be listed on the Plan of Study (POS). For more information on Graduate College Transfer Credit policies, students should review the following link: <http://grad.arizona.edu/academics/program-requirements/masters-degrees>, contact the ABE Academic Program Coordinator, and/or their Graduate College Degree Auditor. Up to six (6) units for a master's degree may be transferred from other accredited institutions. To transfer, the coursework must have been taken for graduate credit, and an A or B grade must have been earned. These grades will not be included in the student's GPA.

6.4 Master's Plan of Study Form

In conjunction with the Major Professor, each student is responsible for developing a Plan of Study by the end of their first semester. The Plan is to be filed on the UAccess GradPath no later than the end of the first semester in residence. The Plan of Study identifies:

1. Courses already completed and planned at The University of Arizona which the student intends to apply toward the graduate degree and
2. Approved Transfer courses.

The student should receive approval from the entire Thesis/Report Committee before submitting his or her Plan of Study into the UAccess GradPath. The Plan of Study must have the approval of the Academic Program Coordinator, the Major Professor, the Minor Advisor, the ABE Director of Graduate Studies, and the Graduate College. For more information on the plan of study, please refer to <http://grad.arizona.edu/gsas/degree-requirements/masters-degrees#plan-of-study>.

6.5 MS Thesis/MS Report Committee Members

Master's Thesis/ Report Committee must consist of three members. At least two members of the committee must be tenure, tenure-track, or continuing appointment UA ABE faculty members (this includes jointly-appointed faculty members). The third member can be another ABE faculty or a faculty member from another department. If the third member is not a tenure-track UA faculty member, he or she must be approved by the Graduate College as a Special Member. Contact the Academic Program Coordinator if you need to request a Special Member. More information about the Graduate College's policy on Thesis/ Report Committee Member qualifications can be found at <https://grad.arizona.edu/gsas/degree-requirements/masters-degrees>.

The Major Professor, who serves as the chair of the committee, (must be a tenure, tenure-track, or continuing appointment ABE faculty member. A member who is not tenure eligible/continuing appointment will not be eligible to serve as sole chair of the committee but can serve as co-chair if approved to do so by the Graduate College. The student's Major Professor must approve the Master's Thesis/Engineering Report Committee members.

The Master's Thesis/Engineering Report Committee must approve the program of study, the master's thesis/report, and participate in the Final Oral Defense for the Master's degree.

6.6 MS Thesis/MS Report Requirements

6.6.1 Thesis Option

Students are required to:

1. Submit a minimum of one paper for publication;
2. Receive approval for submission to a refereed journal from their Thesis/Report Committee and Major Professor; and
3. Listed as the first author in at least one paper approved for submission.

Copies of filed sample Thesis papers are available for check out with the Academic Program Coordinator or via the University Libraries at <http://arizona.openrepository.com/arizona/handle/10150/129649/>.

6.6.2 Engineering Report Option

Students are required to submit a report to their committee following the format required by the department. Typically, if the student is conducting experimental research, they will use the thesis

option format minus the paper requirement. If the student is not conducting experimental research or doesn't have a formal research project, they can use the format in Appendix B.

6.7 Final Oral Defense/Examination

6.7.1 Dates and Deadlines

NOTE: All students should refer to the Graduate College Dates and Deadlines website prior to beginning the following steps: <https://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines>. Scheduling the Final Oral Defense and satisfying all the requirements relating to Final Oral Defense are the sole responsibility of the student.

6.7.2 MS Thesis/Report Defense Process

1. Upon completion of the research work, student writes his/her thesis/report and presents to his/her Thesis/Engineering Report Committee a draft of the thesis/report one month before the proposed defense date recognizing that the defense date should be at least one week before the deadline set for final submission to the graduate college of the semester the student plans to graduate.
2. One week after the submission of the draft, the student meets with her/his committee to present his/her work to the committee.
3. At the meeting, the committee makes the decision whether the student is ready to defend his/her work based on the presentation and draft thesis/report.
4. If the committee agrees that the student is ready to defend his/her thesis/report/, they signify this by signing the Defense Approval Form.
5. If the committee determines that the student is not ready to defend, the Committee Chair/Advisor and student will then send an email notice with the new "Program Completion Date (Graduation Term," to the Academic Program Coordinator, the ABE Director of Graduate Studies, and Graduate College Degree Check Advisor.
6. Once the candidate is approved to defend, the student submits the signed copy of Defense Approval Form to the Academic Program Coordinator within 24 hours of approval by the committee.
7. Students should be aware of the submission date for the final approved thesis for archiving before they set their final defense date see Dates and Deadlines for their graduation term posted on Graduate Website: <https://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines>.

8. If a committee member is absent from the committee meeting, then it is the student's responsibility to meet with that committee member(s) individually and have them sign the Defense Approval Form.
9. Upon receiving the signed Defense Approval Form from the candidate, the Academic Program Coordinator will notify the ABE Director of Graduate Studies via GradPath, and the student may then set the defense date a minimum of two weeks after consultation with the committee members.
10. The Academic Program Coordinator will have the necessary paper work sent to the Graduate College and also send email to the department faculty, students, and staff with the date and location of the defense.
11. The candidate is responsible for posting the announcement of his/her defense (at least one week prior to the defense) with the title, date, and location in the appropriate buildings.

The Major Professor (Graduate Committee Chair) presides over the defense examination. Each of the Thesis/Engineering Report Committee members must receive a copy of the thesis/project report approved by the student's Academic Advisor (not necessarily library-ready copies) at least two weeks prior to the oral examination.

The examination may last over two hours, but cannot be more than three hours and is composed of two parts. In the first part (about 30 minutes), the student gives an oral presentation of the thesis/project report in an open seminar. The presentation may be interrupted to permit questions to clarify points and questions concerning fundamental principles that are directly related to the thesis/project report. The second part of the examination consists of a closed-to-the-public questioning the student on graduate courses, particularly as they relate to the thesis/project.

For Final Oral Examination Instructions, please refer to https://grad.arizona.edu/forms/sites/default/files/uagc_page/finaldefenseinstructions.pdf. Note: The exam cannot exceed three hours. There is no minimum time.

Members of the committee must be present for the entire examination. Per Graduate College policies, a member may participate in the Defense via Skype or GoToMeeting. If a member is not able to participate in person or via Skype or GoToMeeting, the student will need to find another tenured, tenure-track, or continuing-appointment committee member, and update their Committee Appointment form.

6.7.3 Reporting Final Oral Defense (Examination) Results

After the Defense, the Thesis/Engineering Report Committee will determine if the student passed, passed with revisions, or failed the exam. The Major Professor (Committee Chair) will submit the results to the Academic Program Coordinator via email. Results must be reported to the Graduate College prior to the date on which the degree is to be conferred; specific deadlines from the Graduate College are posted online at <https://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines>.

If the candidate passed the final oral defense without revisions, the student may proceed with the submission process. The Major Professor (Committee Chair) should submit a Change of Grade Form to the Graduate College Degree Certification Office. The candidate then submits the approved thesis/report in electronic format to the Graduate College. For further details, refer to the Dissertation/Thesis Submission link at <http://dissertations.umi.com/arizona/>. The thesis/report must be submitted in PDF format on a readable CD to the ABE Academic Program Coordinator. The candidate's Major Professor and Thesis/Engineering Report Committee may require copies of the thesis/report as well, either in electronic format, hardbound, and/or loose pages. The candidate is advised to check with his/her Major Professor for any special requirements.

If the candidate passed the final oral defense with revisions,

1. The Thesis/Engineering Report Committee must determine the date that the student needs to resubmit the corrections to the committee.
2. The Major Professor (Committee Chair) is responsible for ensuring that the student makes the committee's recommendations and notifying the Academic Program Coordinator that the revisions are completed and the student has met the degree requirements. The Chair should submit a Change of Grade Form.
3. The candidate then submits the approved thesis/report in electronic format to the Graduate College. For further details, refer to the Dissertation/Thesis Submission [<http://dissertations.umi.com/arizona/>]. The thesis/engineering report must be submitted in PDF format on a readable CD to the ABE Academic Program Coordinator. The candidate's Major Professor and Thesis/Engineering Report Committee may require copies of the thesis/report as well, either in electronic format, hardbound, and/or loose pages. The candidate is advised to check with his/her Major Professor for any special requirements.

If the candidate failed the final oral defense, the candidate, upon the recommendation of the major department, may be granted a second examination. The result of the second examination is final.

6.8 Accelerated Master of Science Program (AMP)

The Accelerated Master's Program (AMP) in Agricultural & Biosystems Engineering is designed to enable advanced UA undergraduate students to complete both the Bachelor of Science degree in Biosystems Engineering and the Master of Science degree in Agricultural & Biosystems Engineering in a total of five (5) years. This program is available only for undergraduate students in Engineering at the UA. Research experience as an undergraduate is not a requirement, but it is desirable. Thesis and Engineering Report options are available to AMP students. Please refer to section 6.6 for more details on these two options.

6.8.1 Eligibility Criteria

To be eligible to apply for the Accelerated Master's Program, students must:

1. Be a continuing, undergraduate Biosystems Engineering Major at the University of Arizona.
2. Have a minimum cumulative GPA of 3.3.
3. Have completed a minimum of 75 units of undergraduate coursework at the time of application with a minimum of 12 undergraduate units completed in the student's major at the University of Arizona's main campus.

6.8.2 Application

Interested students should contact the Academic Program Coordinator. Only qualified candidates will receive the ABEAMP application access code.

Students should complete their application online in the January of their junior year through the Graduate College at <https://apply.grad.arizona.edu>. Once the student receives the access code, the student will complete the Agricultural and Biosystems Engineering Accelerated Master's Program application. After acceptance into the program, students will register during their senior year to take a combination of undergraduate and graduate courses. These courses will serve both as electives for the BS degree and as core or elective courses for the MS degree. In the fifth and final year, students will focus on graduate coursework and their research or project.

6.8.3 Accelerated Steps to the MS Degree

In the first semester of the senior year (first semester in the AMP), students need to:

1. Review the ABE Graduate Student Handbook.

2. Select their Major Professor.
3. Develop the Plan of Study (POS). An example is in Appendix A.
4. Review the Thesis/Engineering Report Committee requirements.

In the second semester of the senior year (second semester in the AMP), students need to:

1. Select their Thesis/Engineering Report Committee members.
2. Choose their research or project topic.

6.9 Steps in Completing MS Degree

A summary of the steps to complete an MS degree is listed in Appendix C.

7.0 Doctor of Philosophy (PhD) Degree in Agricultural & Biosystems Engineering

Attainment of a Doctor of Philosophy (PhD) degree at The University of Arizona requires outstanding scholarship and demonstration of distinguished research leading to a dissertation that contributes significantly to the general pool of knowledge in the discipline. This section describes the requirements for completion of the PhD degree within the Agricultural & Biosystems Engineering Department. A general timetable for completing the steps for the PhD is given in Appendix C.

PhD students are responsible for knowing the ABE program and Graduate College requirements. PhD students also need to review through the Graduate College Policies and Procedures located at <http://grad.arizona.edu/degrecert>, and the degree requirements for PhD degrees located at <http://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy>.

7.1 Pursuing PhD after MS at the University of Arizona

The Graduate College allows this option subject to the following restrictions: A student may use up to total of 30 credits from master's degrees towards the doctorate. More information may be found at <https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#credit-requirements>.

7.2 Dissertation Committee

The Dissertation Committee consists of at least three faculty members who represent the major subject area and one or more faculty members who represent the minor subject area. The Dissertation Committee approves the Doctoral Degree Plan of Study and constitutes the committee

for the Final Oral Defense of the doctoral dissertation. They also constitute the Comprehensive Examining Committee. Since the Dissertation Committee plays such a central role in the doctoral program, it should be formed soon after selection of the major professor.

The Graduate College requires a minimum of three members, all of whom must be University of Arizona tenured, tenure-track, or approved as equivalent (continuing appointment). The ABE Department requires that a minimum of two (2) members be from the ABE Department and one (1) representative from any UA department from within the student's program specialty area.

The Major Professor (chair of the Dissertation Committee) must be a current UA tenured, tenure-track, or continuing appointment ABE faculty member. A list of eligible ABE Faculty can be found in Appendix D. Special members must be pre-approved by the Dean of the Graduate College. A Special Member Form must be completed and submitted to the Graduate College for Dissertation Committee members who are non-tenured or are outside of The University of Arizona. The form is available on the Graduate College website at <http://grad.arizona.edu/DegreeCertificationForms/SpecialMemberForm.pdf>. Please contact the Academic Program Coordinator to process the Special Member request.

7.3 Credit Requirements

For a Ph.D. in Agricultural and Biosystems Engineering, a candidate must complete 63 units minimum consisting of 45 non-Dissertation units and 18 Dissertation (ABE 920) units. All required units of credit must be at the 500-level or above at The University of Arizona or, in the case of transfer units, their equivalent at other institutions.

7.3.1 Minimum Requirements

63 units minimum, consisting of the following:

1. 3 units of STAT 571B
2. 9 units of either Statistics (can't repeat STAT 571B), Numerical Analysis, Mathematics/Modeling
3. 18 units of ABE courses including:
 - a. 2 units of ABE 501
 - b. 4 units of ABE 696A-002 (students who are presenting).
 - i. EXCEPTION: Candidates with an ABE MS degree are required to take 2 units as the other 2 units were earned from their MS program.

- c. 1 unit of ABE 693 (section # under faculty sponsor)
4. 18 units (minimum) of Dissertation units (ABE 920)
5. 3-6 units minimum of elective courses per approval of Major Professor and depending on the minor requirements
6. Continuous enrollment in ABE696A-001 for each semester he/she is not presenting. Students must receive approval from the Department, to be excused from this requirement.
7. 9 to 12 units **in the minor**: Depending on the Minor Department requirements.
8. All courses in the Plan of Work must be taken for a grade (A, B, C) except for ABE 693 (Teaching Internship) and ABE 696A (Graduate Seminar).

7.4 Transfer Credit

Graduate credit earned at other approved institutions, if accepted by the major department and the Graduate College, may be counted toward the requirements of this degree. Students who wish to use transfer credit must submit a request through the Academic Program Coordinator before the end of their first year of study to the Graduate College.

Transferred units are subject to the following restrictions:

- The credits must be approved by the major or minor department and the Graduate College.
- The minimum grade for transferred credits must be an A or B or the equivalent at the institution where course was taken.
- Transferred units may not count toward more than one doctorate.
- A maximum of 30 units of transfer coursework may be used toward the PhD requirements.

The Graduate Committee will review the petition and determine if the transfer course is equivalent. If the request is approved, the course may be listed on the POS. For more information on Graduate College Transfer Credit policies, students should review the following link:

<http://grad.arizona.edu/academics/program-requirements/doctor-of-philosophy/credit-requirements-and-transfer-credit>, contact the ABE Academic Program Coordinator, and/or contact their Graduate College Degree Auditor.

7.5 PhD Minor Requirements for ABE PhD Candidates

ABE PhD students are required to complete a minor. The minor subject area may be taken or outside of the ABE Department. The student may choose one or two minor areas, which are determined in consultation with his/her Major Professor. The department in which the minor is sought determines

specific requirements. The Graduate College requires that the minimum number of minor coursework is nine (9) units, but most minor programs require twelve (12) units of coursework.

The following are some suggested minors for ABE students: Soil, Water, and Environmental Science; Plant Sciences; Chemical and Environmental Engineering; Civil Engineering and Engineering Mechanics; Electrical and Computer Engineering; Hydrology and Water Resource; Agricultural & Resource Economics; Mathematics; Renewable Natural Resource;, Systems and Industrial Engineering; Aerospace and Mechanical Engineering; Biomedical Engineering; Optical Science.

7.6 Requirements for Minor in ABE

Complete **10 units** consisting of: 9 units of **ABE courses** determined by the student and his/her ABE minor advisor, **and at least 1 unit of ABE 696A seminar presentation**. Students should select their Minor Advisor, and receive approval from their Major advisor, prior to completing the Graduate College Minor application and filing his/her POS. The Minor Advisor will serve on the Graduate Committees.

7.7 Teaching Experience Requirement

The ABE department recognizes that many PhD students will end up in faculty roles, and teaching at universities or colleges. We want to help prepare you for that event. Therefore, all PhD students are required to have one unit of ABE 693 teaching experience. The following are methods to achieve this teaching experience.

Graduate Teaching Experience Options:

1. Mentor with a faculty member to teach **xx** number of classes
2. Take FCSC/CALS 696E, Learner Centered Teaching for Online Delivery: This seminar course is designed to introduce students to common pedagogical issues associated with both assisting in, and teaching learner centered courses in online formats.
3. Take IA 697A, Learner Centered Teaching: Designed for graduate students who will be serving as teaching assistants/graders or who plan to pursue a career in teaching. Pedagogical issues central to teaching/learning at the college level such as learning styles, classroom climate and culture will be covered.
4. Take IA 697B, Using Technology in Teaching: Course combines in-depth reading and discussion related to pedagogical issues in the use of technology in teaching and learning with guided, individually focused training and practice in using technology in teaching.

5. Take IA 697G, Universal Design: Inclusive Learning Environments: This course provides a comprehensive review of the theory, strategies, and techniques used in instructional design processes that foster inclusive learning environments for all learners. The curriculum addresses characteristics of learners such as learning differences and preferences and 21st century learning attributes, approaches for utilizing differentiated instruction, engagement and motivation techniques, classroom management tactics, and universal design strategies. Emphasis will be placed on critical review of the literature as practically applied to various learning environments and contexts in post-secondary education.
6. Complete the Graduate Teaching Certificate through the Office of Instruction & Assessment (<http://oia.arizona.edu/project/certificate-college-teaching-program>).
7. Complete Graduate College Required TA Training On-Line (TATO): <https://grad.arizona.edu/funding/ga/mandatory-online-training>.

Students are required to complete the ABE 693 registration form located at the Academic Program Coordinator's office. All students must complete the Graduate College (TATO) training prior to requesting for enrolment into the ABE 693, from the Academic Program Coordinator. Students are required to have a plan and must select an internship advisor and receive approval from their Major Professor. An Internship Advisor needs to be an ABE Faculty member, but not necessarily the Major Professor. At the end of the Internship a report must be submitted to the internship advisor.

7.8 Time Limitation

Students must complete their degree within five years of passing the Comprehensive Examination. A student not finishing within that time period may be allowed to re-take the Comprehensive Examination with permission of the ABE Graduate Program Director.

7.9 Plan of Study

In conjunction with the Major Professor, each student is responsible for developing a Plan of Study by the end of their first semester. The Plan is to be filed on the UAccess GradPath no later than the end of the first semester in residence. The Plan of Study identifies:

1. Approved Transfer courses;
2. Courses already completed and planned at The University of Arizona which the student intends to apply toward the graduate degree;
3. Approved Minor courses.

The student should receive approval from the entire Dissertation Committee before submitting his or her Plan of Study into the UAccess GradPath. The Plan of Study must have the approval of the **Academic Program Coordinator**, the Major Professor, the Minor Advisor, the ABE Director of Graduate Studies, and the Graduate College. For more information on the doctoral plan of study, please refer to <http://grad.arizona.edu/academics/program-requirements/doctor-of-philosophy/plan-of-study>.

7.10 Comprehensive Examination

Admission to graduate study does not imply admission to candidacy for an advanced degree. Before admission to degree candidacy for the doctoral degree, the student must pass the doctoral Comprehensive Examination (a general examination in the chosen fields of study). This examination is intended to test the student's comprehensive knowledge of the major and minor subjects of study, both in breadth across the general field of study, and in depth within the area of specialization. Therefore, the examination should not take place until the student has completed all, or almost all, of his/her coursework. The exam will determine whether the student will be permitted to continue the PhD program.

7.10.1 Comprehensive Examination Structure

The Comprehensive Examination is considered a single examination and is composed of two parts:

1. A written portion covering the major and minor fields, and
2. An oral portion, which is to be conducted before the candidate's Comprehensive Examination Committee members. The ABE Department recommends that the oral portion be taken no later than two weeks after the successful completion of the written portion. However, the Graduate College allows the oral portion of the Comprehensive Examination to be completed as late as three (3) months before the Final Oral Defense.

7.10.2 Comprehensive Examination Committee & Form

Students should receive verbal approval from their Major Professor and Dissertation Committee members prior to submitting the Comp Exam form in GradPath. The Comprehensive Examination Committee must consist of a minimum of four (4) members. In the ABE department, the practice is for the Comprehensive Examination Committee to consist of the Dissertation Committee with additional member(s). The additional member(s) should be tenured or tenure-track, or an approved special member. Special members must be pre-approved by the Dean of the Graduate College. Please contact the Academic Program Coordinator to process the Special Member request. Any members

beyond the fourth can also be current tenured or tenure-track faculty members, or approved special members. Once the committee has been approved by the assigned approvers, the student will proceed to the Announcement of Comprehensive Examination.

NOTE: All committee members, including the Minor Advisor, must be present and participate in the Comprehensive Examination.

7.10.3 Announcement of Comprehensive Examination

Once the Comprehensive Examination Committee has agreed on a time and place for the exam, the student must complete the Announcement of Comprehensive Examination form in GradPath. The form must be approved by ABE Academic Program Coordinator, Major Professor, Minor Advisor, ABE Director of Graduate Studies, and the Graduate College. Once approved, the form will notify the examining committee of the date and time of the Comprehensive Exam.

7.10.4 Reporting the Results of the Comprehensive Examination

Based on the student's combined performance in the written and oral portions, the examining committee awards a grade of pass or fail. The Major Professor reports the final results of the Comprehensive Examination in GradPath.

If the student passed the comprehensive exam, the student will be Advanced to Candidacy and proceed to completing the Dissertation Committee Appointment form.

If the student failed the comprehensive exam, the student may be permitted a second attempt to pass the examination, but only if recommended by the examining committee. Students will be allowed *no more* than one re-take. For more information on the Comprehensive Examination, please refer to <https://grad.arizona.edu/academics/program-requirements/doctor-of-philosophy/comprehensive-examination> and Policies and Procedures for Oral Comprehensive Examination for Doctoral Candidacy <https://grad.arizona.edu/gcforms/sites/gcforms/files/page/oralcomprehensiveinstructions.pdf>.

7.11 Prospectus Proposal

The Prospectus Proposal is the general research plan that the candidate will pursue to obtain their doctoral degree and is of sufficient academic merit on a topic to that satisfies his/her Dissertation Committee. The candidate is required to send the title of his/her Prospectus Proposal to the Academic Program Coordinator, via email prior to completing the Announcement of Final Oral

Defense. Once the Prospectus is received, the Academic Program Coordinator will submit the Prospectus Proposal form in GradPath.

7.12 Dissertation Requirements

Students are required to submit a minimum of two papers for publication. The publication papers along with the Dissertation must be submitted to the Dissertation Committee for review and approval three weeks prior to scheduling the defense. The student needs to:

1. Receive approval for submission to a refereed journal from their Dissertation Committee and Major Professor.
2. Be listed as the first author in at least one of the papers approved for submission.

Dissertation format requirements can be found in Appendix B. ABE Students should review the Graduate College manual to ensure that their Dissertation is in the proper format. For more information on formatting, please refer to <https://grad.arizona.edu/gsas/dissertations-theses/dissertation-and-thesis-formatting-guides>. Copies of Filed Dissertation papers are available for check out with the Department Academic Program Coordinator or via the University Libraries at <http://arizona.openrepository.com/arizona/handle/10150/129649/>

7.13 Final Oral Defense

Upon the completion and approval of the Dissertation by the Committee, the student is ready to schedule the Final Oral Defense. A student must be in good academic standing to schedule the Final Oral Defense. The examination focuses on the dissertation itself but can include general questioning related to the field(s) of study within the scope of the dissertation. The exact time and place of this Final Oral Defense must be scheduled through GradPath at least two weeks in advance. The Major Professor, who serves as the chair of the committee, presides over the examination. The Defense is closed to the public, except for an initial seminar portion during which the student presents the dissertation and entertains questions. The Final Oral Defense should be concluded within the three time period. Members of the Dissertation Committee must be present for the entire examination. Students should send the Graduate College link for the Final Oral Defense Instructions to their Major Professor at least 1 week prior to the date of the defense. For more information on the UA's policy on the Final Oral Defense, go to

<https://grad.arizona.edu/gcforms/sites/gcforms/files/page/finaldefenseinstructions.pdf>. **NOTE: The ABE faculty support the UA's policy that all members of the committee must be present for the entire examination.**

Per Graduate College policies, a member may participate in the Defense via Skype or GoToMeeting. If a member is not able to participate in person or via Skype or GoToMeeting, the student will need to find another tenured, tenure-track, or continuing-appointment committee member, and update their Committee Appointment form.

7.13.1 Dates and Deadlines

NOTE: All candidates should refer to the Graduate College Dates and Deadlines website prior to beginning the following steps at <https://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines>. Scheduling the Final Oral Defense and satisfying all requirements relating to this examination are the sole responsibility of the student.

7.13.2 Final Oral Defense Process

1. Upon completion of the research work, the student writes his/her dissertation and presents to his/her Dissertation Committee a draft of the dissertation one month before the proposed defense date recognizing that the defense date should be at least one week before the deadline set for final submission to the graduate college of the semester the student plans to graduate.
2. One week after the submission of the draft, the student meets with her/his Dissertation Committee to present his/her work.
3. At the meeting, the Dissertation Committee makes the decision whether the student is ready to defend her/his work based on the presentation and draft dissertation.
4. If the committee agrees that the student is ready to defend his/her dissertation, they signify by signing the Defense Approval Form (see Academic Program Coordinator for a copy of this form).
5. Students should be aware of the submission date for the final approved dissertation for archiving before they set their final oral examination date. Refer to the Graduate College's Dates and Deadlines for graduation at <https://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines>.
6. The student is also responsible to complete the Announcement of Final Oral Defense in UAccess.
7. If the Dissertation Committee determines that the PhD student is not ready to defend, the Academic Program Coordinator will decline the Announcement of Final Oral Defense form in UAccess and notify the ABE Director of Graduate Studies and Department Head of the findings. The Major Professor and student will send an email notice with the new "Program Completion Date (Graduation Term)" to the Academic Program Coordinator, the ABE Director of Graduate Studies, and Graduate College Degree Check Advisor.

8. Upon receiving the signed Defense Approval Form from the candidate, the Academic Program Coordinator will notify the ABE Director of Graduate Studies via GradPath, and the candidate may then set the Final Oral Defense date a minimum of two weeks after consultation with their Dissertation Committee members.
9. The Academic Program Coordinator will have the necessary paper work sent to the Graduate College and also send an email to the department faculty, students, and staff with the date and location of the final oral defense.
10. The student is responsible for posting the announcement, at least a week prior to the final oral defense date. The announcement should include the title, date, and location of the defense.
11. The Academic Program Coordinator will approve the Announcement of Oral Defense form in GradPath. Approval by the Director of Graduate Studies completes the process.

7.13.3 Reporting Results of the Final Oral Defense

After the Final Oral Defense, the candidate's Dissertation Committee will determine if the student passed, passed with revisions, or failed. The Committee should follow the Graduate College procedures for the Final Oral Defense located at <https://grad.arizona.edu/gcforms/sites/gcforms/files/page/finaldefenseinstructions.pdf>.

If the student passed the final oral defense without revisions, the student may proceed with dissertation submission. The Major Professor should submit a **Change of Grade** Form to the Academic Program Coordinator and report the results in GradPath.

If the student passed the final oral defense with revisions,

1. The Dissertation Committee must determine the date that the student needs to resubmit the corrections to the committee.
2. The Major Professor will need to enter this date in the GradPath form.
3. After the Dissertation Committee approves the final corrected revisions, the Major Professor sends an email to the Graduate Auditor and the Graduate Coordinator confirming the final results for degree completion as well as submits a **Change of Grade** Form in GradPath. Once the final revisions are approved, the student will be advised to complete the submission process.

If the student failed the final oral defense, he/she should contact the Graduate College.

7.14 Dissertation Submission

Following a successful Final Oral Defense, the candidate must submit approved dissertation in electronic format to the Graduate College for forwarding to the University of Arizona Library at <http://www.etdadmin.com/cgi-bin/school?siteId=63>. For further instructions, refer to the Dissertation/Thesis Submission site at <https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#final-oral-defense>. The dissertation must also be submitted as an electronic copy to the ABE department. In addition, the candidate's Major Professor and Dissertation Committee may require copies of the dissertation in electronic format. Check with your Major Professor for any special requirements.

Upon receipt of the finalized dissertation, the Dean of the Graduate College will recommend conferral of the doctoral degree by the Arizona Board of Regents. Once the Graduate College Degree Auditor receives the final result for the Defense they will send the student information on the Dissertation Submission process.

7.15 Dual Degrees

A number of dual degree programs are available. These allow qualified students an opportunity to earn two degrees with a reduction in the total number of credit hours required. Dual degree programs allow students to use a certain number of units in common between the two degrees. The number of shared units varies by the dual degree program. Please contact individual departments for more specific information about their dual degree programs.

APPENDIX A
EXAMPLE OF PLAN OF STUDY FOR THE ACCELERATED MASTER'S PROGRAM
(AMP)

Senior Year/1st Year in AMP

Course	Unit	Course	Unit
Fall Semester		Spring Semester	
ABE 496a (Seminar in Engr Careers & Professions)	1	ABE 498b (Biosystems Engineering Design 2)	3
ABE 498a (Biosystems Engineering Design 1)	3	500-level ABE Elective	3
500-level ABE Elective	3	500-level ABE Elective	3
500-level TECH Elective	3	400-level TECH Elective	3
AME 324a (Mechanics of Materials)	3	Tier 2 ART/HUM	3
Tier 2 INDV	3		
ABE 393 (Internship)	1		
Total	17	Total	15

AMP 2nd Year

Course	Unit	Course	Unit
Fall Semester		Spring Semester	
ABE 696a-002 (Presenting Seminar)	1	ABE 696a-002 (Presenting Seminar)	1
500-level ABE Elective	3	STAT 571b	3
500-level TECH Elective	3	ABE 501	2
ABE 910 (Thesis) or ABE 909 (Engineering Report)	3	ABE 910 (Thesis) or ABE 909 (Engineering Report)	2
Total	10	Total	8

APPENDIX B

THESIS/MS ENGINEERING REPORT/DISSERTATION REQUIREMENTS

Objectives

MS Thesis Option and PhD students are required to submit papers for publication refereed scientific journals by the time of their Final Oral Examination. The primary objectives of the option are:

- i. To encourage graduate students to learn the submission/publication processes of refereed journals before graduation and
- ii. To shorten the process of publishing papers from thesis/dissertation.

Similar options are available in many European and US institutions (including at least two departments at the UA). Sample Thesis and Dissertation papers completed under this option are available in the department for check out. These are also available through the UA library. If you have any questions, please do not hesitate to contact the Director of Graduate Studies and/or your Faculty Advisor.

Guidelines

- MS – one paper/manuscript with the student as the first author approved for submission to a refereed journal by the committee and the major advisor is required.
PhD – two papers/manuscripts with the student as the first author in at least one paper approved for submission to a refereed journal by the committee and the major advisor is required.
- Prior to the submission of each manuscript, a Faculty Advisor's (and co-advisor's, if any) approval is required. After the Faculty Advisor's review, each manuscript must be approved by majority of the Advisory Committee members (or all Dissertation Committee members if there are three or less). Please remember to attach the signature page for the ABE paper for each manuscript. Signature page can be obtained Appendix E.
- The Advisory Committee will decide when the paper is ready for defense. Students must give a copy of the penultimate paper **three weeks** (minimum) before the scheduled defense.

Recommended Thesis/Dissertation Format

Title Page

Signature Page (dissertation only)

Statement by Author

Acknowledgements

Dedication

Table of Contents (begins with List of Illustration/Tables)

List of Illustrations (from Introduction & Present Study)

List of Tables (from Introduction & Present Study)

Abstract

Chapter 1. Introduction

- Explanation of the problem(s), objectives, and uniqueness.
- The relationship of the manuscripts included and your contribution to each of the manuscripts.
- Specify your role in the research and production of the manuscript(s). Where research efforts are part of larger collaborative project, identify one aspect of the project as your own and demonstrate an original contribution.
- An overall literature review and background.

Chapter 2. Present Study

- Overall summary.
- Overall conclusions and recommendations.

Appendices:

- Manuscript No. 1¹
- Manuscript No. 2¹
- Supplementary materials - Materials such as data tables, additional references, graphs, computer programs, and maps.
- All appendix pages are part of the single pagination sequence of the thesis/dissertation.

¹The first page each manuscript must include the title, a list of co-authors, and a refereed journal to which the manuscript was submitted. The statement of permission for use of copyrighted material should be attached if needed.

Recommended Engineering Report (Non-thesis) Format

NOTE: This format is intended for those students not conducting specific research. If conducting experimental research, follow the Thesis format guidelines minus the requirement for submitting a paper.

Executive Summary

Abstract

Acknowledgments

Introduction

- Statement of Problem

- Background

- Purpose and Overview of the Project

Methods and Design Approach

- Alternative Analysis

 - Preferred Alternative Decision Matrix

- Technical Description

- Specifications

- Construction Materials

- External Constraints

Operation & Maintenance

Lifecycle Cost

Intellectual Property

Draft Business Plan (Advisor's Discretion, can be an appendix)

- Company Structure

 - Company Type (LLC, S Corp, C Corp)

 - Organization and Management

- Market Analysis

 - Need/Market analysis

 - Sales Strategy

 - Sales Projections

Financial Analysis

Capital Financing Requirements

Operating Capital Requirements

Cash Flow Projections

Growth Potential

Conclusions

How well does the product actually work?

Does the product solve the problem that your company wanted to be solved?

What are the weaknesses and limitations of your product?

What parts of the original problem were more difficult than anticipated?

What hopes for your solution did not turn out?

Recommendations

What recommendations do you have for the company?

Should they begin immediate production of the prototype?

Should they do further testing of the prototype?

Should they put out an RFP for further research? Should they do a market study?

References and Citations

Follow APA standard format throughout text

APPENDIX C

CHECKLISTS FOR COMPLETING THE STEPS IN THE MS, AMP, AND PhD DEGREES

CHECKLIST FOR COMPLETING THE STEPS IN THE MS DEGREE

Activity	Deadline
Choose Major Professor	End of 1 st semester
Choose Graduate Committee	End of 1 st semester
Meet with Major Professor and Graduate Committee to establish PLAN OF STUDY	End of 1 st semester
Submit the PLAN OF STUDY to GradPath	End of 1 st semester
Submit draft THESIS/ENGINEERING REPORT to Graduate Committee for approval to defend	Final Semester: 1 month <i>before</i> proposed defense date AND 1 week <i>before</i> meeting with Graduate Committee
Meet with Graduate Committee	Final Semester: 1 week <i>after</i> submitting draft Thesis/Engineering Report
Submit signed DEFENSE APPROVAL form to Academic Program Coordinator	Final Semester: Within 24 hours of meeting with Graduate Committee to review draft Thesis/Engineering Report
Schedule FINAL ORAL DEFENSE date with Graduate Committee	Final Semester: Date must be no later than 1 week <i>before</i> Graduate College deadline for final submission AND 2 weeks <i>after</i> meeting with Graduate Committee to review draft Thesis/Engineering Report
Post FINAL ORAL DEFENSE announcement	A minimum of a week before the defense date
COMPLETION OF DEGREE REQUIREMENTS done by the Academic Program Coordinator after receiving the final defense result from the major professor	The major professor should report to the Academic Program Coordinator on the day of the defense: <ol style="list-style-type: none"> 1. If pass with revision, the revision due date must be entered and must be before the graduate college due date. <ol style="list-style-type: none"> a. On the date the revision is due, the major professor needs to report results of either pass or fail. b. If the revisions are not completed on time, the major professor should contact the Academic Program Coordinator and the Graduate College. 2. If fail, contact the Academic Program Coordinator and the Graduate College.
Submit electronic copy of THESIS/ ENGINEERING REPORT to the Graduate Degree Certification Office. For instructions, see http://grad.arizona.edu/gcforms/ETD_Diss_Manual.pdf	Final semester: upon completion of degree requirements
Submit electronic copy to ABE Department Head	Final semester: upon completion of degree requirements

CHECKLIST FOR COMPLETING THE STEPS IN THE ACCELERATED MASTER'S PROGRAM

Activity	Deadline
Choose Major Professor	End of last semester of the senior year
Choose Thesis/Engineering Report Committee	End of last semester of the senior year
Meet with Major Professor and Graduate Committee to establish PLAN OF STUDY	End of last semester of the senior year
Submit the PLAN OF STUDY to GradPath	Semester following the end of last semester of the senior year
Submit draft THESIS/ENGINEERING REPORT to Graduate Committee for approval to defend	Final Semester: 1 month <i>before</i> proposed defense date AND 1 week <i>before</i> meeting with Graduate Committee
Meet with Graduate Committee	Final Semester: 1 week <i>after</i> submitting draft Thesis/Engineering Report
Submit signed DEFENSE APPROVAL form to Academic Program Coordinator	Final Semester: Within 24 hours of meeting with Graduate Committee to review draft Thesis/Engineering Report
Schedule FINAL ORAL DEFENSE date with Graduate Committee	Final Semester: Date must be no later than 1 week <i>before</i> Graduate College deadline for final submission AND 2 weeks <i>after</i> meeting with Graduate Committee to review draft Thesis/Engineering Report
Post FINAL ORAL DEFENSE announcement	A minimum of a week before the defense date
COMPLETION OF DEGREE REQUIREMENTS done by the Academic Program Coordinator after receiving the final defense result from the major professor	The major professor should report to the Academic Program Coordinator on the day of the defense: <ol style="list-style-type: none"> 1. If pass with revision, the revision due date must be entered and must be before the graduate college due date. <ol style="list-style-type: none"> a. On the date the revision is due, the major professor needs to report results of either pass or fail. b. If the revisions are not completed on time, the major professor should contact the Academic Program Coordinator and the Graduate College. 2. If fail, contact the Academic Program Coordinator and the Graduate College.
Submit electronic copy of THESIS/ ENGINEERING REPORT to the Graduate Degree Certification Office. For instructions, see http://grad.arizona.edu/gcforms/ETD_Diss_Manual.pdf	Final semester: upon completion of degree requirements
Submit electronic copy to ABE Department Head	Final semester: upon completion of degree requirements

CHECKLIST FOR COMPLETING THE STEPS IN THE PhD DEGREE

Activity	Deadline
Meet with ABE Director of Graduate Studies to discuss options and procedures for choosing a Major Professor	First few weeks beginning the program
Choose Major Professor	End of 1 st semester
Choose Dissertation Committee	End of 1 st semester
Meet with Major Professor and Dissertation Committee to establish PLAN OF STUDY	End of 1 st semester
Submit the PLAN OF STUDY to GradPath	End of 1 st semester
Completion of announcement of COMPREHENSIVE EXAMINATION in GradPath	After completing all/most of coursework
Complete written portion of COMPREHENSIVE EXAMINATION	After completing all/most of coursework
Complete oral portion of COMPREHENSIVE EXAMINATION	Within 2 weeks of successful completion of written portion
Submit PROSPECTUS PROPOSAL to Academic Program Coordinator	Prior to completing Announcement of Final Oral Defense
Submit 2 papers for publication and draft DISSERTATION to Dissertation Committee for approval to defend	Final Semester: 3 weeks prior to date of oral examination/defense OR 1 month before proposed date of oral examination/defense
Meet with Dissertation Committee	Final Semester: 1 week after submitting draft Thesis/Engineering Report
Submit signed DEFENSE APPROVAL form to Academic Program Coordinator	Final Semester: Within 24 hours of meeting with Dissertation Committee to review draft Dissertation and 2 publications
Schedule FINAL ORAL DEFENSE date with your Dissertation Committee	Final Semester: Date must be no later than 1 week before Graduate College deadline for final submission AND 2 weeks after meeting with Dissertation Committee to review draft dissertation and 2 publications
Schedule FINAL ORAL DEFENSE date through GradPath	At least 2 weeks in advance of the Oral Defense And at least 2 weeks after meeting with Dissertation Committee
Post FINAL ORAL DEFENSE announcement	A minimum of a week before the defense date
COMPLETION OF DEGREE REQUIREMENTS form to the Graduate Degree Certification Office	The major professor should report to the Academic Program Coordinator AND login to GradPath on the day of the defense: <ol style="list-style-type: none"> 1. If pass with revision, the revision due date must be entered and must be before the graduate college due date. <ol style="list-style-type: none"> a. On the date the revision is due, the major professor needs to report results of either pass or fail. b. If the revisions are not completed on time, the major professor should contact the Academic Program Coordinator and the Graduate College.

Activity	Deadline
	2. If fail, contact the Academic Program Coordinator and the Graduate College.
Submit electronic copy of DISSERTATION to the Graduate Degree Certification Office. For instructions, see http://grad.arizona.edu/gcforms/ETD_Diss_Manual.pdf	Final semester Final semester: upon completion of degree requirements
Submit electronic copy to ABE Department Head	Final semester: upon completion of degree requirements

APPENDIX D

List of Faculty Who Can Serve on Committees as sole Graduate Committee Chairs

NOTE: Anyone not on this list may serve as a co-chair, but not as a sole chair.

An, Lingling, Associate Professor, PhD, 2008, Purdue University. **Statistical bioinformatics, statistical methods for detecting and predicting biological threats.**

Andrade-Sanchez, Pedro, Associate Professor & Extension Specialist, PhD, 2004, University of California, Davis. **Precision agriculture.**

Barton, Jennifer, Interim Vice President for Research and Jointly-appointed Professor in Biomedical Engineering, PhD, 1998, The University of Texas at Austin. **Translational biomedical optics, and the prevention and early detection of cancer.**

Cuello, Joel, Professor, PhD, 1994, Pennsylvania State University. **Bioreactor design and scale up, algae production systems, controlled-environment systems, cell and organ cultures regulations.**

Didan, Kamel, Jointly-appointed Research Associate in Electrical & Computer Engineering, PhD, 1999, University of Arizona. **Remote sensing data, algorithms, and modeling time series analysis.**

Duan, Guohong “Jennifer,” Jointly-appointed Associate Professor in Civil Engineering & Engineering Management, PhD, 1998, University of Mississippi. **Experimental studies and computational simulation of turbulent flow, sediment transport, and channel morphological processes.**

Farrell-Poe, Kathryn “Kitt,” Department Head, Professor, and Extension Specialist, PhD, 1990, Purdue University. **Water quality, onsite wastewater treatment, safe drinking water, extension education/outreach.**

Fitzsimmons, Kevin, Jointly-appointed Professor in Soil, Water, and Environmental Sciences, PhD, 1999, University of Arizona. **Aquaculture.**

Franklin, Edward, Jointly-appointed Associate Professor in Agricultural Education, PhD, 2000, Oklahoma State University. **Renewable energy.**

Giacomelli, Gene, Professor, Extension Specialist, and Director of the Controlled Environment Agriculture Program, PhD, 1983, Rutgers University. **Horticultural engineering, energy conversions engineering, bioresource engineering, greenhouse engineering design, hydroponic crop production.**

Hurwitz, Bonnie, Assistant Professor, PhD, 2012, University of Arizona. **Bioenvironment & one health, functional metagenomics, big data, system biology, bioinformatics and computational biology.**

Kacira, Murat, Professor, PhD, 2000, Ohio State University. **Controlled environment agriculture, food, agricultural, and biological engineering.**

Kubota, Chieri, Jointly-appointed Professor in School of Plant Sciences, PhD, 1994, University of Tokyo. **Controlled environment agriculture, plant physiology.**

Livingston, Peter. ABE Associate Professor of Professional Practice, PE, PhD, 2013, University of Arizona. **Water resources, alternative energy, controlled environment agriculture.** [NOTE: can only serve as co-chair]

Martin, Edward, Professor, Extension Specialist, and Director of the Maricopa County Extension, PhD, 1992, Michigan State University. **Water resources, irrigation management.**

Ogden, Kimberly, Jointly-appointed Professor in Chemical & Environmental Engineering, PhD, 1991, University of Colorado, Boulder. **Bioreactor design for production of alternative e fuels from algae and sweet sorghum and microbiological water quality.**

Pepper, Ian, Jointly-appointed Professor in Soil, Water, and Environmental Sciences and Director of the Water Quality Center, PhD, 1975, The Ohio State University. **Soil microbiology.**

Piegorsch, Walter, Jointly-appointed Professor in Mathematics & Chair of Statistics GIDP, PhD, 1984, Cornell University. **Statistics.**

Poe, Stephen, Professor and Extension Specialist, PhD, 1987, Purdue University. **System mechanization, livestock waste management, ventilation housing, and computer software development.**

Seraphin, Supapan. Jointly-appointed Professor in Materials Science Engineering, PhD, 1990, Arizona State University. **Carbon nanoclusters, silicon-on-insulator materials, various ceramic and magnetic nanoparticles, mining materials, and catalysts.**

Siemens, Mark, Associate Professor and Extension Specialist, PhD, 1996, University of Arizona. **Specialty crops mechanization, agricultural machine design and testing, tillage.**

Slack, Donald, Professor, PE, PhD, 1975, University of Kentucky. **Irrigation scheduling, water resources, infiltration, porous media flow, soil and water conservation engineering.**

Tamimi, Akrum, Jointly-appointed Associate Professor in Soil, Water, and Environmental Sciences, PhD, 1995, University of Arizona. **Irrigation engineering, water resources, computer modeling.**

Waller, Peter, Associate Professor, PhD, 1990, University of California, Davis. **Water quality engineering, irrigation engineering, drainage engineering.**

Yitayew, Muluneh, Professor and ABE Director of Graduate Studies, PhD, 1982, University of Arizona. **Irrigation engineering, hydraulics, water resources engineering.**

Yoon, Jeong-Yeol, Professor, PhD, 2004, University of California, Los Angeles. **Biosensors, water safety, lab-on-a-chip, protein nanoarray, immunoassay, biomaterials.**

APPENDIX E

FORMS

THESIS/DISSERTATION PAPER CERTIFICATION
FOR
SUBMITTED/PUBLISHED MANUSCRIPT

DEPARTMENT OF AGRICULTURAL AND BIOSYSTEMS ENGINEERING
THE UNIVERSITY OF ARIZONA

As members of the Graduate Committee/final examination committee, we have read the manuscript(s)

Prepared by: _____

Entitled: _____

Approved submission to: _____

In partial fulfillment of the requirements for the degree of: _____

APPROVED BY:

Major Professor (*print and sign name*)

Date

Committee Member (*print and sign name*)

Date

Committee Member (*print and sign name*)

Date

Committee Member (*print and sign name*)

Date

ORAL DEFENSE APPROVAL FORM
DEPARTMENT OF AGRICULTURAL AND BIOSYSTEMS ENGINEERING
THE UNIVERSITY OF ARIZONA

As members of the Graduate Committee, we certify that we have read the Thesis/Engineering Report/Dissertation and confirm that the student is ready to defend.

Student _____ *Student ID:* _____

Title: _____

APPROVED BY:

Major Professor (*print and sign name*)

Date

Committee Member (*print and sign name*)

Date

Committee Member (*print and sign name*)

Date

Committee Member (*print and sign name*)

Date

APPENDIX F

ASSESSMENT RUBRICS

THE UNIVERSITY OF ARIZONA
Department of Agricultural and Biosystems Engineering
ABE 696A GRADUATE SEMINAR
Speaker Evaluation Sheet

NAME OF SPEAKER _____ **DATE:** _____

Use the following areas of consideration to comment positively or negatively, but always helpfully, on the presentation given.

	Rating	5 = Best	3	2	1 = Worst
Articulation and professional demeanor: Did the speaker speak out with a clear voice? Pronounce all words well? Was there a voice drop off? Were there any distracting mannerisms? Did the speaker speak too fast or too slow?	5	4	3	2	1
	<u>Comments:</u>				

Organization: Was there a meaningful introduction to the topic that set the stage for what was to come? Were the ideas presented in a logical order? Was the speaker easy to follow? Was there a solid summary and/or conclusions? Were we prepared for the end?	5	4	3	2	1
	<u>Comments:</u>				

Quality and appropriateness of visual aid: Did slides meet all dimensional requirements? Were there enough slides to support the message? Could you understand all slides?	5	4	3	2	1
	<u>Comments:</u>				

Use of Time: Was an appropriate amount of time devoted to each part of the presentation? Did the speaker end on time? Did he/she appear rushed? Was time used effectively?	5	4	3	2	1
	<u>Comments:</u>				

Response to questions: Were questions answered clearly? Was response limited to the question asked?	5	4	3	2	1
	<u>Comments:</u>				

OTHER COMMENTS:

**ABE Assessment Rubric:
Thesis/Report/Dissertation Oral Defense**

Student Name: _____

Thesis/Report/Dissertation: _____

Committee Member: _____ **Date:** _____

Directions

Evaluate this student's written thesis/report/dissertation and oral defense of the research with a score between 1 (Needs Improvement) and 5 (Excellent) for each of the criteria described below. Briefly comment on the rationale if your score is less than 5. Turn your complete rubric to the committee chair before leaving the defense.

Score (1 – 5)	Criterion	Comment
	The thesis/report/dissertation is well written.	
	The problem is clearly described with adequate critical analysis of the related research literature.	
	The research design for studying the problem is appropriate.	
	The data are adequately analyzed.	
	The conclusions drawn from the analysis are well defended. The student adequately responds to challenges to his/her interpretations and conclusions.	
	The student demonstrates the ability to extrapolate his/her research to broader implications for the field.	
	The student demonstrates the ability to anticipate the logical next level of inquiry.	

Exit Survey for Graduate Students

Place an "X" in each row to indicate the degree to which your graduate program provided you the opportunity to:

	Excellent	Good	Neutral	Fair	Comments
Acquire broad knowledge in my focus area					
Develop skills in critical analysis of research literature in the program					
Design and conduct original research on the ABE problem					
Improve my ability to defend research results in scientific peers					

1. Please describe learning opportunities for other specific skills or knowledge that this academic program should improve upon.

2. Please provide us with your email and mailing address for future communications from the ABE Department.