Graduate Manual for the Biosystems Engineering Programs
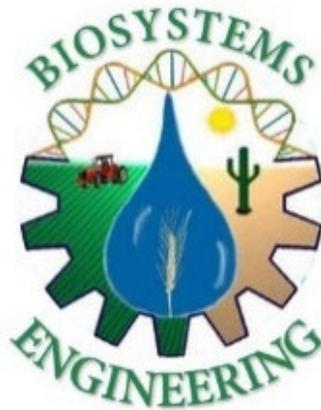
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BIOSYSTEMS ENGINEERING (BE) MISSION, PURPOSE, VISION, VALUES

Mission

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

Purpose

BE develops and facilitates the use of innovative technologies for the 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

BE 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 in our programs.

Shared Values

Innovation   We are innovative in our solutions and how we approach engineering, life science, and data science practices to solve grand challenges.

Inclusiveness   We bring together different people, ideas, backgrounds, and perspectives to produce lasting solutions for all. We encourage and help all to be successful.

Interdisciplinary   We embrace on-campus collaboration to develop better solutions that address the needs of all.

Cooperation   We forge off-campus partnerships to solve society's complex problems and improve the quality of life.

Sustainability   We manage the use of natural resources to maintain healthy ecosystems throughout the production cycle of food, bioenergy, and bioproducts.

Connectedness   We work with industry and communities to understand tomorrow's needs and open up opportunities for our students and alumni to help.

Ethics   High ethical standards and sound decision-making are at the heart of our research, discovery, business, and financial practices.

1.0   INTRODUCTION

This handbook provides students with information on the requirements and procedures for pursuing a graduate degree (AMP, MS, or PhD) in the Department of Biosystems Engineering (BE) at The University of Arizona. The Department is active in research. We have four general emphasis areas: 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 BE 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 program's flexibility allows foreign and domestic students to develop programs specifically suited to their career goals and interests in consultation with their advisors. The University of Arizona is a diverse institution and therefore provides courses in many different areas to support specific and general programs.

This manual is a compilation of current policies, practices, and procedures of the Graduate School and the Department of Biosystems Engineering. Information found in the Graduate Catalog [http://catalog.arizona.edu/policy-audience/graduate], 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 manual.

This manual contains general program information, admission requirements, general administration of the graduate program, and deadlines for 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 the official deadline dates can be obtained from the BE Academic Advisor or the Graduate College website [http://grad.arizona.edu/].

2.0   DEGREE PROGRAM INFORMATION

The Department offers the following degrees:
- Biosystems Engineering:
    - Accelerated Master of Science (AMP)
    - Traditional Master of Science (2-year MS)
    - Doctor of Philosophy (PhD)
- Biosystems Analytics & Technology
    - Traditional Master of Science (2-year MS)
    - Doctor of Philosophy (PhD)

Students in either of the MS programs have the option of completing a thesis or a report. The thesis option 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. It will also prepare the student for the independent research needed for the PhD program. The report option is intended for students desiring a broad education and engineering practice. It comprises coursework in several areas and an engineering report under the supervision of the student's major professor and the student's committee members.

2.1   BE Accelerated Master's Program (AMP)

The BE Accelerated MS program (AMP) provides Biosystems Engineering BS (BEBS) majors with the opportunity to leverage their undergraduate coursework into a graduate degree by enabling advanced BEBS undergraduate students to complete both the Bachelor of Science degree and the Master of Science degree (BEMS) in a total of 5 years. The AMP is designed for the top BEBS undergraduate students who plan to pursue a graduate degree in Biosystems Engineering. Biosystems Engineering majors must have a 3.30 GPA or higher to qualify for the program. AMP students may complete up to 12 units of graduate-level coursework during the fourth year of their BEBS program. AMP students

will receive credit toward their *BS and MS after completing* the course requirements with a 3.0 GPA or higher. The AMP students who chose the MS report option typically complete the remainder of the MS program requirements within one year.

2.2   Traditional Master of Science (2-year MS)

A Master's degree involves advanced training gained through intensive study, beyond the bachelor's degree, in a special field (or major) supplemented by study in supporting subjects. The MS in Biosystems Engineering is designed for graduate engineers and scientists aspiring to advance their careers or prepare themselves for advanced degrees or research opportunities.

2.3   Doctor of Philosophy (PhD)

Obtaining a Doctor of Philosophy (PhD) in the Biosystems department is for students seeking an intense research focus and academic contributions to either the biosystems engineering or biosystems analytics & technology disciplines. The doctoral program prepares engineers for senior responsibility in industry, research, or teaching. The successful candidate must demonstrate the ability to devise and execute a program of study and research which makes a fundamentally new contribution to the chosen field. The most important aspect of the doctoral program is the dissertation, which is the evidence of this fundamental contribution. The student should be prepared for a very demanding period of study beyond the master's degree. A minor field will also be a part of the departmental doctoral programs.

3.0   ADMISSION

3.1   General Admission Requirements

All candidates must apply online through the Graduate College application site at: [https://apply.grad.arizona.edu/users/login]. Graduate Admission Requirements are listed in the Graduate Catalog and Program Descriptions: [https://grad.arizona.edu/catalog/]. The application for admission includes official transcripts from all   previous colleges and universities attended, a resume (CV), three letters of recommendation, and the applicant's statement of purpose. NOTE: applications for the Accelerated Master's Program are for Fall semester admittance only. Other graduate programs can be admitted in both the fall and spring semesters.

The GPA requirements differ depending on the graduate program:
- BE AMP: GPA = 3.3
- 2-year MS: GPA = 3.0
- PhD: GPA = 3.3

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

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3.2   BE Admission Requirements

To be considered for the BE MS program, the candidate must hold a Bachelor's degree in engineering or BS in a STEM field and complete required deficiency courses. To be considered for the BE PhD program, the candidate must hold a BS and/or MS degree in engineering or BS and/or MS in a STEM field and complete ENGR deficiency courses.

3.3   BAT Admission Requirements

To be considered for the BAT MS program, the candidate must hold a Bachelor's degree. To be considered for the BAT PhD program, the candidate must hold a BS and/or MS degree. Candidates with degrees from non-STEM fields may be asked to complete additional coursework.

For more details on the admission process, please see [http://grad.arizona.edu/admissions/requirements].

3.4   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, refer to the Graduate College policies: [https://grad.arizona.edu/international-students].

4.0   FINANCIAL SUPPORT IN THE BE DEPARTMENT

There are several funding options available to graduate students. 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) per BE department policy.

4.1   Graduate Research and Teaching Assistantships

Graduate Assistants/Associate (GA) positions [https://grad.arizona.edu/funding/gaships] are designed to provide students with work, valuable experiences, while and support the departments teaching, research, and outreach missions. Graduate Research Assistantships/Associateships (GRAs) and Graduate Teaching Assistantship/Associateships (GTAs) positions are appointed based on funding allocations. Graduate Assistants (GRA/GTA) receive tuition remission based on FTE (full-time equivalent). Students on .25FTE (10 hours a week) qualify for 50% tuition remission. Students on .50 FTE (20 hours a week) qualify for 100% tuition remission. GA Nonresident Tuition rates are recalculated to the resident rate. Students are responsible for paying University fees. Students needing to delay payment for tuition and fees can enroll in the GA Deferment Plan [https://grad.arizona.edu/funding/ga/benefits-appointment#tuition-deferment]. Students holding a Graduate Teaching Assistantship must be evaluated by their instructor at the end of each semester to qualify for continued service and for future GA positions in the department.

4.1.1   Graduate Research Assistantships (GRAs)
The department provides a limited number of GRA positions, based on budget, typically offered to incoming PhD students. Additional GRAs may be supported by an individual faculty member's research grant(s). Faculty members are responsible for identifying students to work on funded projects.

4.1.2   Graduate Teaching Assistantships (GTAs)
A limited number of department 0.25 & 0.50 FTE GTA positions are available each semester. Students hired on GTAs need to review policies and complete training and orientations required by the Graduate College [https://grad.arizona.edu/funding/ga].

4.2 Hourly Graders

The BE Department often offers hourly grader positions on a class-by-class basis. Contact either the Academic Program Manager or the Department Head for possible opportunities.

4.3   Fellowships, Scholarships and Grant Funding

Graduate students are encouraged to apply for fellowships, scholarships, and grants to support their academic journey.

Fellowships and Scholarships Graduate students seeking funding for their studies or research can also find helpful information through the Graduate Center Office of Fellowships [http://gradcenter.arizona.edu/gcof]. Many other scholarship funding resources are available through Scholarship Universe [http://scholarshipuniverse.arizona.edu/].

ProQuest-Pivot-RP: The ProQuest database [https://proquest.libguides.com/pivot] provides students and faculty with access to identifying funding to support research.

Thesis/Dissertation Scholarship International students who have completed their coursework within two years of completing their PhD degree or two semesters of completing their MS degree may qualify for this Graduate College Scholarship. This award excludes the mandatory registration fees and any additional tuition the individual charges. Students hired as GRA or GTA appointments do not qualify for this waiver. For more information on this scholarship, see https://grad.arizona.edu/funding/opportunities/thesis-dissertation-tuition-scholarships.

5.0   GENERAL ADMINISTRATION OF THE GRADUATE PROGRAM

5.1   Orientations and Required Training

5.1.1   Graduate School
New students (international and domestic) need to attend the New Student Orientations offered by Colleges, International Student Office, and University Graduate Professional Student Council (GPSC).

Graduate Teaching Assistants must attend CALS GAT orientation in addition to completing the required TA Training sessions.

5.1.2   Departmental
Departmental New Graduate Student Orientations are conducted by the department's Director of Graduate Studies and the Academic Program Manager.

5.2   Registration

Registration is accomplished using UAccess [http://www.uaccess.arizona.edu/], the University's course registration program. Graduate students are responsible for enrolling in their course work (including the BE 909/910/920 units) during the open enrollment period. Registration for the first semester in residence should be completed with the Academic Program Manager.

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5.3 Deficiencies

Candidates with identified course deficiencies must complete the required coursework satisfactorily before completing their graduate degree program. If a student disagrees with the written statement of deficiencies given at the time of admission, they should contact the Academic Program Manager to file a petition for a review.

5.4 Continuous Enrollment Policy for Domestic Students

To be considered full-time, domestic graduate students must enroll in 6 units per semester. Students who cannot enroll in the fall or spring semester need to submit a Leave of Absence form. 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 readmission by the Associate Dean of Academic Programs.

5.4.1 Summer Enrollment
MS and PhD students who plan to defend their Report/Thesis/Dissertation and have completed their required coursework are not required to enroll in a Summer Session.

5.4.2 International Students
International students need to follow their individual visa enrollment requirements. For more information regarding the University of Arizona's international graduate student enrollment policies, [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 Teaching Assistant (GTA) or Graduate Research Assistant (GRA) are expected to enroll in at least six-nine units per semester, depending on the funding source (refer to notice of appointment). Individual Colleges may set their own GTA/GRA enrollment requirements.

College of Agriculture & Life Sciences (CALS) and College of Engineering (COE) GA Requirements Graduate Assistants/Associates (GA) hired as GTA/GRA must enroll in at least nine units during the first semester of their GA contract. GAs may enroll in 6 units, after their first time serving as a GA.

For more information on Graduate College GA enrollment requirements, [https://grad.arizona.edu/funding/ga].

5.4.4 Graduate Scholarships
Students who have been awarded Graduate Registration Scholarships or Graduate Tuition Scholarships are required to enroll as full-time students per Graduate College policies, [http://grad.arizona.edu/funding/opportunities].

5.5 Graduate Committee Meetings

Students are expected to meet with their committee members at least once a semester. The purpose of the meeting(s) is to have each committee member review the student's academic progress.

5.6 Leave of Absence Policy

Graduate students may apply for a Leave of Absence from a program for a semester or for the academic year using the Graduate Petition for a Leave of Absence, [https://grad.arizona.edu/gsas/gradpath/graduate-petition-and-graduate-petition-user-guides].

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Graduate students are expected to review the Graduate College requirements, [https://grad.arizona.edu/policies/enrollment-policies/leave-absence] and meet with the Academic Program Manager, prior to filing a LOA petition. International students must also meet with the International Students Programs and Services Advisor before filing for a Leave of Absence.

An LOA may affect the status of a graduate student's financial aid. Only academic services or facilities available to the general public can be used during the LOA. Students are responsible for determining the requirements of their funding agency and/or academic unit before applying for a Leave of Absence.

Students who fail to enroll/register and does not have an approved Leave of Absence on file, will be discontinued from their program. A new graduate application will be necessary for the student to return and continue their program. Re-admission is not guaranteed. See Continuous Enrollment [https://grad.arizona.edu/policies/enrollment-policies/continuous-enrollment] and Re-admission Policies [https://grad.arizona.edu/admissions/types/readmission-requirements] for more information.

5.7   Enrollment in Departmental Graduate Seminar (BE 596A/B)

BE 596A and 596B are combined for a single departmental graduate seminar course. It is intended to enhance graduate student development through the exchange of scholarly information through the combination of graduate-student research presentations, guest presentations, discussion, reports, and/or papers. There is an expectation that all graduate students will participate in either BE 596A or 596B continuously throughout their graduate program.

5.7.1   BE 596A (Presenting Class)
MS students must enroll in two (2) units, and PhD students must enroll in four (4) units during their graduate program. These units will be included in the student's plan of study. Students enrolled in BE 596A class must give a presentation on their research/project to the class and the course assignments to receive credit. PhD students who have proof that they have made a graduate presentation in another institution or UA graduate program may petition and receive a waiver, and permission to apply the UA/Transfer course towards the PhD unit requirements in the student's Plan of Study (POS). Grades available are A, B, C, D, E, I, W.

5.7.2   BE 596B (Non-presenting Class)
MS students are required to enroll in (2) units of 596B, and PhD students are required to enroll in four (4) units of 596B. These units will be included in the student's plan of study. Students enrolled in the 596B section are expected to coordinate and preside over the seminar presentations and the course assignments to receive a passing grade. Grades available are S, P, F, I, W.

Students who have completed their 596A/B credit requirements must enroll in 596B as a guest in the D2L system for the remainder of their tenure in the program. To remain in good standing in the program, these students must complete the graduate program assignments posted in D2L and are encouraged to attend the weekly seminar.

5.7.3   International Students on a Thesis/Dissertation Scholarship Award
International students on a Thesis or Dissertation Scholarship Award are waived from the enrollment requirement for 596A. However, these students are required to register as a guest and attend the course and meet all other requirements.

5.8   UAccess GradPath

Students are expected to complete their Graduate College degree certification forms through GradPath [http://uaccess.arizona.edu/], the Graduate College's degree audit system. Students can access GradPath through their UAccess Student accounts. Once a student completes the required form in GradPath, the form automatically \

routes to everyone who needs to see or approve the form. The BE Academic Program Manager can assist with this process.

5.9   UAccess GradPath Forms

Each of the following steps requires completion and should be taken at the appropriate time during the student's tenure in 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/].

5.9.1   Responsible Conduct of Research Statement
Students must complete the UAccess GradPath Responsible Conduct training to gain access to their required forms.

5.9.2   Plan of Study (POS) Form
In conjunction with their major professor, each student is responsible for developing and submitting a Plan of Study (POS). Two-year MS and PhD students must submit the POS forms before the last day of the second semester. BEAMP students must submit the POS during the first semester of the BEMS. Before creating the POS, students should read the Graduate College's requirements [http://grad.arizona.edu/gsas/degree-requirements}. Courses listed in the POS must match the actual course enrollment/course completion posted in UAccess. Students who make changes to their UAccess course enrollments, after receiving approval for their POS, must modify and submit the POS for reapproval. For further information on the POS, MS students should see section 6.4, and the PhD students should see section 7.8.

5.9.3   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, and the title of their Thesis/Dissertation. For more information on submitting and archiving your thesis/dissertation, [https://grad.arizona.edu/gsas/degree-requirements/masters-degrees#thesis-committee].

5.9.4   Degree (MS, AMP, PhD) Completion Form
The Academic Program Manager is responible for recording the MS student final oral defense results via the MS GradPath Completion form. The PhD student's Major Professor/Committee Chair is responsible for completing the Final Oral Defense result form. For more information, [http://grad.arizona.edu/gsas/degree-requirements].

5.10 Graduate Student Academic Progress Reports

Graduate students must submit a Graduate Student Academic Progress Report annually per Graduate College Requirements. The Director of Graduate Studies will review Progress Reports for completion. The department offers a Progress Checklist that helps you to identify milestones and deadlines. These forms are located on the Graduate Programs D2L support site.

5.11 Enrollment in Multiple Graduate Degree Programs

University of Arizona students may pursue simultaneous multiple graduate degrees. Students must go through the UA Graduate College application system and meet all admission requirements. Please refer to the Graduate College Program Description Guide [https://grad.arizona.edu/futurestudents/].

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5.12 Thesis/Dissertation Publication Requirements

All MS thesis option and PhD candidates must 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.

5.13 Archiving the Thesis/Dissertation

Students completing a MS thesis (BE 910) or PhD dissertation (BE 920) are required to archive their thesis/dissertation. The final thesis/dissertation documents **must** be completed and archived in the University of Arizona Campus Repository maintained by ProQuest/UM by the Graduate College Dates and Deadlines for graduation [https://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines] during the student's expected graduation term. All requirements for the Master's/Doctoral degree, including passing the Final oral defense, receiving Major Professor/ Committee Chair's approval to archive and publish the final thesis/dissertation (with no edits or revisions remaining) before the Graduate College deadlines. Students who are not able to meet the Graduate College deadlines/requirements are required to change their expected graduation term and notify the Academic Program Manager of their progress, one month before the end of the semester.

5.14 Commencement

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

5.14.1 University Commencement
The University of Arizona holds its 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 the 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.

5.14.2 College of Agriculture & Life Sciences (CALS)
The College of Agriculture and Life Sciences has hooding ceremonies twice a year, at the end of each academic semester. BAT and BE Graduate students will be expected to select a Faculty Member to perform the Hooding ceremony.

5.14.3 College of Engineering (COE)
The College of Engineering holds a commencement/hooding ceremony at the end of the fall semester. BE Graduate students can attend both this ceremony and the CALS hooding ceremony. BE Graduate students will be expected to select a Faculty Member to perform the Hooding ceremony.

5.14.4 Biosystems Engineering Department
The BE department holds a pre-commencement reception/dinner twice a year -- at the end of each academic semester. Students completing degree requirements in August can attend 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.

5.15 International Student Resources

International students must familiarize themselves with the Office of Global Initiatives for International Students [http://global.arizona.edu/] and review the Student Resource Manual at [http://global.arizona.edu/international-students/student-resource-manual].
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International students should check with the Office of International Student Programs to confirm requirements for compliance with their visa status requirements since they may be required to be enrolled in additional units to maintain full-time student status. Students should also check their I-20 expiration date and, if necessary, begin the renewal process. Students need to give themselves plenty of time to maintain their status. The process may take up to 6 months or more.

5.16 Graduate Student Learning Outcomes Assessment

5.16.1. Expected Learning Outcomes

5.16.1.1 Masters of Science
By the completion of the Graduate program, master's students in the Biosystems Engineering Department will:
1. demonstrate knowledge of their focus area in the department,
2. critically analyze published research results in their focus area in the department,
3. conduct research on their focus area, and
4. demonstrate effective communication skills and defend the results of research to peers and broader scientific audiences.

5.16.1.2 Doctor of Philosophy
By the completion of the Graduate program, Doctoral students in the Biosystems Engineering Department will:
1. demonstrate a broad knowledge of their focus area in the department,
2. critically evaluate published research results in their focus area in the department,
3. produce and conduct original research on their focus area,
4. add to the body of knowledge of their discipline, and
5. effectively communicate and defend the results of research to peers and broader scientific audiences.

5.16.2. Assessment Activities
Assessments will be conducted throughout the graduate student's tenure in the BE Department, as shown in Tables 1 and 2. Common to all graduate programs in the BE department are the requirements of graduate seminar presentations, the oral defense of the research or creative activity, and the written exit survey. In addition to these common elements, the BE and BAT PhD programs require students to complete a comprehensive exam based on coursework and knowledge of their focus area. These already-existing assessment activities are also used to gather program-level assessment data. Appendix F has the rubrics for the assessments found in Tables 1 and 2.

Table 1. Graduate program assessments for Master's students.

Assessment Activities	Outcome 1: Knowledge of the Focus Area	Outcome 2: Critical Analysis of Research in the Focus Area	Outcome 3: Conduct Research	Outcome 4: Communicate and/or Defend Research
BE 501, Research Methods in Biosystems Engineering	X			X
Graduate Seminar Presentations (BE 596A)		X		X
Oral Defense of the Report/Thesis[1]	X	X	X	X
Written Exit Survey	X	X	X	**X**
[1]For example of rubric, see Appendix F				

Table 2. Graduate program assessments for Doctoral students.

Assessment Activities	Outcome 1: Broad Knowledge of the Focus Area	Outcome 2: Critical Evaluation of Research in the Focus Area	Outcome 3: Conduct Original Research	Outcome 4: Add to Body of Knowledge	Outcome 5: Communicate and/or Defend Research
BE 501, Research Methods in Biosystems Engineering	X				X
Graduate Seminar Presentations (BE 596A)		X		X	X
Oral Comprehensive Exam[1]	X				
Oral Defense of the Dissertation[1]	X	X	X		X
Submit Manuscript to a Peer-reviewed Journal or Conference Proceedings				X	
Written Exit Survey	X	X	X		X
[1]For example of rubric, see Appendix F					

6.0   MASTER'S OF SCIENCE (MS) DEGREE IN THE BIOSYSTEMS ENGINEERING DEPARTMENT

The Biosystems Engineering Department offers three Master of Science degree programs: Accelerated Masters (AMP) in Biosystems Engineering and two Traditional Masters (2-year MS) in Biosystems Engineering and Biosystems Analytics & Technology. This section summarizes the requirements and steps for completing the AMP or the 2-year MS program. Students in both the AMP and the 2-year MS programs are responsible for knowing the departmental program and Graduate College requirements. Students also need to review the Graduate College Policies and Procedures [http://grad.arizona.edu/policies] and the degree requirements for Master's degrees at [https://grad.arizona.edu/catalog/]. The requirements for Master's Degrees on the Graduate College website [http://grad.arizona.edu/gsas/degree-requirements] provide additional details. Students in the BEAMP and 2-year BEMS programs may choose either the thesis or graduate report option to complete their degree requirements. NOTE: Students must apply to the BEMS in their second semester of the BEBS AMP graduate program. Once the BS degree is awarded, the AMP student will be considered a BE MS graduate student. Graduate Units taken in the BEBS will be transferred into the BE MS program. The checklist for completing the steps toward the degree is located in Appendix C.

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6.1 Credit Requirements

6.1.1 Traditional BAT MS

For an MS in Biosystems Analytics & Technology, students must complete a minimum of 30 units consisting of the following:

- 1 unit BE 597A (Effective 08-2020; for prior catalogs, can be substituted with 1 unit or BE 593 or Elective course)
- 2 units of BE 501
- 2 units of BE 596A (presenting)
  - MS students not presenting in a particular semester will register for BE 596B
- 2 units of 596B (non-presenting)
  - Students must receive approval from the Department to be excused from this requirement.
  - Continuous enrollment in either BE 596A or 596B is expected. As per the Graduate College policy, any units exceeding the 2 units of BE 596B will not be listed on the student's GradPath Plan of Study.
- 3 units BE 513
- 3 units BE 534
- 3 units STAT 571B
- 3 units ENVS 508
- 6 units of elective courses (per Major Professor's approval)
  - May choose to complete a 1-unit lab rotation experience (BE 593) as an elective
- 5 units of either BE 910 Thesis (thesis option) or BE 909 Graduate Report (non-thesis option) under their Major Professor's section number

All courses in the Plan of Study must be taken for a grade (A, B, C) except for BE 596B (S, P, F) and the optional 1-unit lab rotation (BE 593). 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 https://grad.arizona.edu/admissions/requirements.

6.1.2 BE AMP

BEBSAMP students must complete a minimum of 30 units consisting of the following:

- 1 unit BE 597A (Effective 08-2020; for prior catalogs, can be substituted with 1 unit or BE 593 or Elective course) – NOTE: this will be a technical elective for your BS Advisement Report
- 2 units of BE 596A (presenting)
  - MS students not presenting in a particular semester will register for BE 596B
  - NOTE: 1 unit will be a technical elective for your BS Advisement Report
- 2 units of BE 596B (non-presenting)
  - Students must receive approval from the Department to be excused from this requirement.
  - Continuous enrollment in either BE 596A or 596B is expected. As per the Graduate College policy, any units exceeding the 2 units of BE 596B will not be listed on your GradPath Plan of Study.
  - NOTE: 1 unit of BE 596B will be a technical elective for your BS Advisement Report
- 2 units of BE 501 – NOTE: this will be a technical elective for your BS Advisement Report
- 3 units STAT 571B
- 3 units ENVS 508 – NOTE: this course satisfies the technical writing requirement on your BS Advisement Report
- 9 units of BE courses (limit of 3 units of house-numbered courses, i.e., 592, 593, 599)
- 3 units of an Elective course (per Major Professor's approval)
  - May choose 1-unit lab rotation (BE 593) as an elective
- 5 units of either BE 910 Thesis (thesis option) or BE 909 Graduate Report (non-thesis option) under their Major Professor's section number

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All coursework must be in courses graded A, B, or C except for house-numbered courses, i.e., 592, 593, 599.
AMP students may not take more than 12 units of graduate course work while in their senior year of the AMP.
Students enrolled in the BEAMP must maintain a 3.0 GPA in the program to be able to register for courses.
A student whose GPA falls below 3.0 will not be permitted to register for additional courses
[https://grad.arizona.edu/admissions/requirements]. AMP students are required to complete the Undergraduate
Enrollment form [https://grad.arizona.edu/policies/enrollment-policies] during their final year of their BS program to
receive permission to enroll in their 500-level coursework.

6.1.3   Traditional BE MS

For an MS in Biosystems Engineering, students must complete a minimum of 30 units consisting of the following:

- 1 unit BE 597A (Effective 08-2020; for prior catalogs, can be substituted with 1 unit or BE 593 or Elective course)
- 2 units of BE 501
- 2 units of BE 596A (presenting)
    - MS students not presenting in a particular semester will register for BE 596B
- 2 units of 596B (non-presenting)
    - Students must receive approval from the Department to be excused from this requirement.
    - Continuous enrollment in either BE 596A or 596B is expected. As per the Graduate College policy, any units exceeding the 2 units of BE 596B will not be listed on the student's GradPath Plan of Study.
- 3 units STAT 571B
- 3 units ENVS 508
- 9 units of BE courses (limit of 3 units of house-numbered courses, i.e., 592, 593, 599)
- 3 units of elective courses (per Major Professor's approval)
    - may choose a 1-unit lab rotation experience (BE 593) as an elective
- 5 units of either BE 910 Thesis (thesis option) or BE 909 Graduate Report (non-thesis option) under their Major Professor's section number

All courses in the Plan of Study must be taken for a grade (A, B, C) except for BE 596B (S, P, F) and the optional 1-unit lab rotation (BE 593). 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 [https://grad.arizona.edu/admissions/requirements].

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 are not accepted toward meeting degree requirements [http://grad.arizona.edu/gsas/degree-requirements/masters-degrees#time-limitation].

6.3   Transfer Credit

Graduate Course Transfer credits may apply towards the MS degree. Up to six (6) units for a master's degree may be transferred from other accredited institutions. The minimum grade for transferred graduate-level credits must be an A or B or the equivalent at the institution where the course was taken. The transfer grades are not included in the student's UA GPA.

Students who wish to have Transfer units apply towards their MS degree must communicate with the Academic Program Manager with the desired substitutions and may be required to provide course descriptions and/or syllabi.
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The Graduate Program Committee will review the requested substitutions and determine if the transfer course(s) are equivalent. The course may be listed on the Plan of Study (POS) if approval is granted. Refer to the Graduate College Transfer Credit policies [http://grad.arizona.edu/academics/program-requirements/masters-degrees] and contact the BE Academic Program Manager.

6.4   Master's Plan of Study (POS) Form

In conjunction with the Major Professor, each student is responsible for developing a Plan of Study (POS) by the end of their first semester. The two-year MS Plans of Study must be filed in GradPath no later than the end of the first semester in residence. Students enrolled in the AMP program must file their Plan of Study in GradPath at the beginning of their first year in the BEMS (3rd semester in the AMP). 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 their Plan of Study into the GradPath. The Plan of Study must have the approval of the Academic Program Manager, the Major Professor, the Minor Advisor (if applicable), the BE Director of Graduate Studies, and the Graduate College.

Courses listed in the POS must match the actual course enrollment/course completion posted in UAccess. Students who make changes to their UAccess course enrollments, after receiving approval for their POS, must modify and submit the POS for reapproval [http://grad.arizona.edu/gsas/degree-requirements/masters-degrees#plan-of-study].

6.5   MS Major Professor

In the first few weeks after joining the program, students need to meet with the BE Director of Graduate Studies to discuss options and procedures for choosing a Major Professor. A permanent Major Professor must be selected 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 they are making satisfactory progress. The Major Professor will act as the student's mentor, be responsible for *helping* the student select their MS Graduate Committee members and serve as the Graduate Committee chair and develop a Plan of Study in collaboration with the Graduate Committee. The Major Professor is responsible for meeting with the student a minimum of once per semester to review the student's progress.

The primary responsibilities of a Major Professor include the following:

1. Be a source of academic information for their graduate student(s);
2. Provide assistance with details in determining the plan of study;
3. Be proficient in inputting, managing, and approving forms in GradPath as needed to assure smooth progression to the final degree;
4. Act as the student's Graduate Committee Chair; and
5. Provide regular, timely input to their students to determine academic progress.

6.5.1   Faculty Eligible to Serve as the MS Major Professor
The Major Professor must be a member of the Biosystems Engineering Graduate Faculty (see Appendix D). A Graduate Faculty member from other programs/departments may not serve as the sole major professor but may serve as a co-chair/co-major professor.

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6.6 MS Graduate Committee

Each graduate student will form a graduate committee. The Master's Graduate Committee approves the program of study and the master's thesis/report and assesses the Final Oral Defense and report/thesis for awarding the Master's degree.

The responsibilities of the graduate committee are to:
1. mentor their graduate students in their research and research practices
2. assist in choosing classes to build skills and knowledge
3. approve their graduate students' plans of study
4. meet with the graduate student at least once a semester
5. review and approve their graduate student's progress reports
6. attend the final oral defense
7. assess student progress and measure ability to meet program objectives

6.6.1 Faculty Eligible to Serve on the MS Graduate Committee

Master's Graduate Committee must consist of three members. At least two committee members must be a member of the Biosystems Engineering Graduate Faculty. The third member can be another BE faculty or a Graduate Faculty member from another program/department. If the third member is not a member of a Graduate Faculty, they must be approved by the Graduate College to serve as a Special Member. Special member requests are initiated by the Academic Program Manager and approved by Graduate College [https://grad.arizona.edu/forms/gsas/special-member-request]. Please contact the Academic Program Manager to process the Special Member request. Appendix D states the criteria for departmental Graduate Faculty for both MS programs in the department as well as a list of the members of the Biosystems Engineering Graduate Faculty.

6.7 MS Thesis/Graduate Report Requirements

The thesis option is the typical and traditional option to articulate the findings of the master's research. This option is valuable to demonstrate the student's ability to express, in writing, their work is the precursor for the dissertation; and may initiate the student's publishing record.

Students may choose the graduate report option when:
- When the research project is not funded
- When the research is limited in scope
- When the research is not publishable work, but the industry would/could value the information
- When the research is related to a project at their work

Depending on the scope of the project, the major professor or graduate committee may require the thesis route. Students must complete the thesis option to receive a Graduate Assistantship (GA) or tuition waivers.

Once the Plan of Study has been submitted (and the thesis/report option is declared), the student is expected to complete the chosen option. NOTE: this option is declared in GradPath, so AMP students cannot declare their option until they apply to the Graduate College.

6.7.1 Thesis Option

Students are required to
1. submit a minimum of one journal article paper for publication,
2. receive approval for submission to a refereed journal from their Committee and Major Professor,
3. be listed as the first author in at least one paper approved for submission, and

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4. consistently use a standard style guide for in-text citations and in the Reference/Citation List. See additional guidance in Appendix B.

Copies of archived thesis papers are available through the University Libraries [https://libguides.library.arizona.edu/type/theses].

6.7.2 Graduate Report Option

Students must submit a graduate 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.

6.8 Research Proposal

The Research Proposal is the general research plan that the candidate will pursue to obtain their master's degree and is of sufficient academic merit on a topic that satisfies their Thesis Committee. The candidate is encouraged to include the title of their Research Proposal in their Plan of Study. A draft of the Research Proposal will be completed by the completion of BE 501 (as a course requirement). The final Research Proposal will be completed by the end of the 2nd semester in the program and submitted to the appropriate BE Graduate Programs D2L Assignment box. The MS Research Proposal must include the selected option: thesis or report.

6.9 Final Oral Defense/Examination

6.9.1 Dates and Deadlines

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

6.9.2 MS Thesis/Report Defense Process

The following lists the steps needed to complete the Master's Thesis or Report Defense:
1. Upon completion of the research work, the student writes their report or thesis and presents it to their Master's Graduate Committee as the final draft (penultimate version) not less than **one month before** the proposed defense daterecognizing that the defense date needs to be at least one week before the Graduate College final submission deadline of the semester the student plans to graduate.
2. The Master's Graduate Committee decides if they need 1 or 2 weeks to review the report or thesis.
3. After the predetermined interval (at least one week but no more than two weeks), the student sends to their committee the departmental *Final Oral Defense Approval* form (forms are found in Appendix E and BE Graduate Program D2L site in the Forms section). This form indicates that the committee has read the report/thesis and believes the student is ready to defend the report/thesis.
4. If the committee agrees that the student is ready to defend their report/thesis, they signify by signing the *Final Oral Defense Approval* form. The student uploads the signed *Final Oral Defense Approval* form to the appropriate D2L assignment folder.
   - If the committee determines that the student is not ready to defend, the Committee Chair and student will then send an email notice with the new "Program Completion Date (Expected Graduation Term)" to the Academic Program Manager, the BE Director of Graduate Studies, and Graduate College Degree Check Advisor [https://grad.arizona.edu/directories/degreeauditors.html].
5. Once the candidate is approved to defend, the student may set the defense date with consultation of the committee members.

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- Students need to be aware of the Graduate College Dates and Deadlines final submission date for the final approved thesis for archiving before they set their final defense date [https://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines]. Students should take into consideration and reserve time for additional revisions/edits that may be assigned at the Oral Defense when scheduling their defense with their committee.

6. Upload the Departmental MS Defense Announcement to the appropriate D2L assignment folder. The Announcement template is available in D2L Graduate Programs Student Support site >> Content >> Forms.
7. Upload the completed and signed *Journal Article Certification* form to the appropriate D2L assignment folder. NOTE: MS-thesis candidates are required to complete *at least* 1 journal article, and it must be included in either the body or the appendix of the thesis. The *Journal Article Certification* is typically the major professor certifying that your paper has been published, in-review, or submitted.
8. Once the approved Journal Article Certification, Final Oral Defense Approval, and Defense Announcement forms are uploaded to D2L, the Academic Program Manager will send the student's announcement out to the students, staff, and faculty in the department. **It is the responsibility of the student to send a calendar reminder to their committee members**.

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

The examination may last over two hours but cannot be more than three hours and is composed of two parts:
1. **Public presentation**. During the first part (about 30-45 minutes), the student gives an oral presentation of the thesis/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/report.
2. **Committee Assessment**. The second part of the examination consists of a closed-to-the-public questioning by the thesis/report committee members on the student's knowledge of the discipline and their research project.

Please refer to the Final Oral Examination Instructions located under Steps to defense on the BE Graduate Program D2L site [https://d2l.arizona.edu/d2l/le/content/1043691/viewContent/10909473/View].

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

Students are discouraged from serving food and drinks other than water for their oral defense. NOTE: bottled water can be obtained from the department.

6.9.3 Reporting Final Oral Defense (Examination) Results
After the Defense:
1. The student's Graduate Committee will determine if the student passed, passed with revisions, or failed the exam.
2. The Major Professor (Committee Chair) will submit the results to the Academic Program Manager via email. Results must be reported to the Graduate College before the date on which the degree is to be conferred [https://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines].
3. If the candidate **passed the final oral defense *without* revisions**, the student may proceed with the submission process.

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- The Major Professor (Committee Chair) notifies the Academic Program Manager of the student's status of "Pass with no revisions" and processes a Change of Grade Form in UAccess Instructor.
- The Department Academic Program Manager records the results of the MS defense in GradPath after receiving confirmation of approval of the FINAL thesis from the Major Professor.
- Candidates who complete a thesis must submit the final approved thesis electronically to the Graduate College [http://dissertations.umi.com/arizona/]. Candidates who completed the MS Report option are not required to submit their final report in the ProQuest system.
- Candidates are required to provide electronic copies of the final thesis/report to the Major Professor, Committee members, and the Academic Program Manager. The candidate is advised to check with their Major Professor for any special requirements.

4. If the candidate **passed the final oral defense *with* revisions**, the following steps need to be taken:
   - The Graduate Committee must determine the date the student needs to resubmit the corrections to the committee.
   - The Major Professor (Committee Chair) is responsible for ensuring that the student makes the committee's recommendations and notifying the Academic Program Manager that the revisions are completed and the student has met the degree requirements. The Chair needs to submit a Change of Grade Form.
   - The Department Academic Program Manager records the results of the MS defense in GradPath after receiving confirmation of approval of the FINAL thesis from the Major Professor.
   - Candidates who complete a thesis must submit the final approved thesis electronically to the Graduate College [http://dissertations.umi.com/arizona/]. Candidates who completed the MS Report option are not required to submit their final report in the ProQuest system.
   - Candidates are required to provide electronic copies of the final thesis/report to the Major Professor, Committee members, and the Academic Program Manager. The candidate is advised to check with their Major Professor for any special requirements.

6. If the candidate **fails the final oral defense**, the candidate may be granted a second examination upon the recommendation of the major department. The result of the second examination is final. Students who fail the examination should meet with their committee members to discuss the next steps.

7.0   Doctor of Philosophy (PhD) Degree in Biosystems Engineering and Biosystems Analytics & Technology

Attainment of a Doctor of Philosophy (PhD) degree at The University of Arizona requires outstanding scholarship and demonstrated distinguished research leading to a dissertation that contributes significantly to the general pool of knowledge in the discipline. This section describes the requirements for completing the PhD degree within the Biosystems Engineering Department.

PhD students are responsible for knowing the BE program and Graduate College requirements. PhD students also need to review the Graduate College Policies and Procedures [http://grad.arizona.edu/degreecert] and the degree requirements for PhD degrees [http://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy].

7.1   Pursuing PhD after MS at the University of Arizona

For both PhD programs, the department requires a minimum GPA of 3.3 in the student's MS program. A student may use a maximum of 25 credits from their UA Biosystems Analytics & Technology or UA Biosystems Engineering master's degree(s) towards their doctorate program [https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#Credit%20Requirements,%20Transfer%20Credit,%20Prior%20Learning].

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7.2   Major Professor

In the first few weeks after joining the program, students need to meet with the BE Director of Graduate Studies to discuss options and procedures for choosing a Major Professor. A permanent Major Professor must be selected 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 they are making satisfactory progress. The Major Professor will act as the student's mentor, be responsible for *helping* the student select their PhD Graduate Committee members and serve as the Graduate Committee chair and develop a Plan of Study in collaboration with the Graduate Committee. The Major Professor is responsible for meeting with the student a minimum of once per semester to review the student's progress.

The primary responsibilities of a Major Professor include the following:

1. Be a source of academic information for their graduate student(s);
2. Provide assistance with details in determining the plan of study;
3. Be proficient in inputting, managing, and approving forms in GradPath as needed to assure smooth progression to the final degree;
4. Act as the student's Graduate Committee Chair; and
7. Provide regular, timely input to their students to determine academic progress.

7.2.1   Faculty Eligible to Serve as the PhD Major Professor

The Major Professor must be a member of the Biosystems Engineering Graduate Faculty. A list of faculty who can serve on doctoral committees as sole graduate doctoral committee chairs can be found in Appendix D. No other faculty can serve as the sole chair of a doctoral committee. Faculty not meeting the endorsement criteria as set in Appendix D will need a co-chair that does meet the endorsement criteria as set in Appendix D.

NOTE: The Academic Program Manager 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.

7.3   PhD Graduate Committee

The PhD Graduate Committee approves the Doctoral Degree Plan of Study and constitutes the committee for the Final Oral Defense of the doctoral dissertation. They may also constitute the Comprehensive Examining Committee. Since the PhD Graduate Committee plays such a central role in the doctoral program, it should be formed soon after the selection of the major professor.

The responsibilities of the graduate committee are to:
1. mentor their graduate students in their research and research practices
2. assist in choosing classes to build skills and knowledge
3. approve their graduate students' plans of study
4. meet with the graduate student at least once a semester
5. review and approve their graduate student's progress reports
6. attend the final oral defense
7. assess student progress and measure ability to meet program objectives

7.3.1   Faculty Eligible to Serve on the PhD Graduate Committee

The PhD Graduate 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. A minimum of two major-subject-area faculty must be from the Biosystems Engineering Graduate Faculty; the third major-subject-area faculty member may be from
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inside or outside the department. The Graduate College requires a minimum of three members, all of whom must be a member of a Graduate Faculty or be approved as equivalent. Appendix D states the criteria for departmental Graduate Faculty for both graduate programs in the department and the list of the members of the Biosystems Engineering Graduate Faculty. If a student desires a committee member who is an expert in their field but who not a member of a Graduate Faculty, the student may request a that expert to be admitted as a Special Member. Please contact the Academic Programs Manager to process the Special Member request [https://grad.arizona.edu/forms/gsas/special-member-request].

7.4 Credit Requirements for PhD

For a PhD in Biosystems Engineering, a candidate must complete 63 units (minimum) consisting of 45 non-Dissertation units and 18 Dissertation (BE 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.

7.4.1 Minimum Course Requirements for BAT PhD

For a PhD in Biosystems Analytics & Technology, students must complete a minimum of 63 units, consisting of the following:

- 1 unit BE 597A (Effective 08-2020; for prior catalogs, can be substituted with 1 unit or BE 593 or Elective course)
- 1 unit of BE 693 (section # under faculty sponsor)
- 2 units of BE 501
- 3 units of BE 513
- 3 units of BE 534
- 3 units of STAT 571B
- 3 units of ENVS 508
- 4 units of BE 596A (presenting)
    - Any units exceeding the 4 units of BE 596A will not be listed on the student's Plan of Study
    - EXCEPTION: Candidates with a BAT MS degree are only required to take 2 units because the other 2 units were earned from their MS program
- 4 units of 596B (non-presenting)
    - Continuous enrollment in BE 596B for each semester they are not presenting is expected. Students must receive approval from the Department to be excused from this requirement
    - As per Graduate College policies, any units exceeding the 2 units of BE 596B will not be listed on the student's GradPath Plan of Study
- 9-12 units of elective courses per approval of Major Professor (depending on the required minor units)
    - may choose a 1-unit lab rotation experience (BE 593) as an elective
- 18 units (minimum) of Dissertation units (BE 920)
- 9-12 units in the minor, depending on the Minor Department requirements

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7.4.2 Minimum Course Requirements for BE PhD

For a PhD in Biosystems Engineering, students must complete a minimum of 63 units, consisting of the following:

- 1 unit BE 597A (Effective 08-2020; for prior catalogs, can be substituted with 1 unit or BE 593 or Elective course)
- 1 unit of BE 693 (section # under faculty sponsor)
- 2 units of BE 501
- 3 units of STAT 571B
- 3 units of ENVS 508
- 4 units of BE 596A (presenting)
    - Any units exceeding the 4 units of BE 596A will not be listed on the student's Plan of Study
    - EXCEPTION: Candidates with a BE MS degree are only required to take 2 units as the other 2 units were earned from their MS program
- 4 units of BE 596B (non-presenting)
    - Continuous enrollment in BE 596B for each semester they are not presenting is expected. Students must receive approval from the Department to be excused from this requirement
    - As per the Graduate College policies, any units exceeding the 2 units of BE 596B will not be listed on the student's GradPath Plan of Study
- 6 units of either Numerical Analysis or other approved Mathematics/Statistics/Modeling courses
- 9 units of BE courses (limit of 3 units of house-numbered courses, i.e., 592, 593, 599)
    - may choose a 1-unit lab rotation experience (BE 593) as an elective
- 0 to 3 units of elective courses per approval of Major Professor (depending on the required minor units)
    - may choose a 1-unit lab rotation experience (BE 593) as an elective
- 18 units (minimum) of Dissertation units (BE 920)
- 9 to 12 units in the minor, depending on the Minor Department requirements

All courses in the Plan of Study must be taken for a grade (A, B, C) except for BE 693 (Teaching Internship) and 1 unit of lab rotation (BE 593).

7.5 Transfer Credit

Graduate credit earned at other approved institutions, if accepted by the department and the Graduate College, may be counted toward the PhD degree requirements. Students who wish to have Graduate Transfer units apply towards their PhD degree must communicate with the Academic Program Manager with the desired substitutions and may be required to provide course descriptions and/or syllabi.

Transferred units are subject to the following restrictions:
1. The credits must be approved by the major or minor department and the Graduate College.
2. The minimum grade for transferred credits must be an A or B or the equivalent at the institution where the course was taken.
3. Transferred units may not count toward more than one doctorate.
4. A maximum of 30 units of transfer coursework may be applied 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 Plan of Study. Please reference Graduate College Transfer Credit policies, [http://grad.arizona.edu/academics/program-requirements/doctor-of-philosophy/credit-requirements-and-transfer-credit], and contact the BE Academic Program Manager.

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7.6   PhD Minor Requirements for BAT and BE PhD Candidates

BAT/BE PhD students are required to complete a minor. The minor subject area may be taken inside or outside of the BE Department, BUT it must be in a different area than the major focus. The student may choose one or two minor areas, determined in consultation with their Major Professor. Students must select their Minor advisor and receive approval from their BE Major Professor before completing the Graduate College Minor application and filing their POS. The Minor Advisor will serve on the PhD Graduate Committee.

The department in which the minor is sought determines specific requirements. The Graduate College requires at least nine (9) units of minor coursework; however, minor programs require nine (9) to twelve units (12) units. Students must confirm the minor requirements with the minor program [https://grad.arizona.edu/catalog/].

- Suggested minors for BE PhD: Soil, Water, and Environmental Science; Plant Sciences; Chemical and Environmental Engineering; Civil Engineering and Engineering Mechanics; Electrical and Computer Engineering; Hydrology and Water Resource; Resource Economics; Mathematics; Renewable Natural Resource; Systems and Industrial Engineering; Aerospace and Mechanical Engineering; Biomedical Engineering; and Optical Science.

- Suggested minors for BAT PhD: Bioinformatics, Biostatistics, Controlled Environment Agriculture, Ecology, Health Informatics, Informatics, Management Information Systems, Math, Microbiology, Natural Resources, Remote Sensing, Renewal Natural Resources, Science Information Systems, and Statistics.

7.7   Requirements for Minoring in BAT or BE

To minor in Biosystems Analytics & Technology or Biosystems Engineering, a candidate must complete 10 units consisting of:
- 9 units of departmental courses determined by the student and their BAT/BE minor advisor, and
- at least 1 unit of BE 596A, Graduate Seminar presentation.

If departmental PhD students minor in one of the BE department's BAT or BE program and as per the Graduate College policies, PhD students cannot double-dip between Major and Minor course work. See Courses Shared Between Degrees section on the Grad College Doctor of Philosophy requirements page, "No course may be counted toward the requirements for more than two plans (at UA or elsewhere)."

Students must select their BAT/BE Minor advisor and receive approval from their Major advisor before completing the Graduate College Minor application and filing their POS. The Minor Advisor will serve on the PhD Graduate Committee.

7.8   Teaching Experience Requirement

The BE department recognizes that many PhD students will have a faculty role and teach at universities or colleges. We want to help prepare our students for that event. Students are required to complete the PhD Teaching Experience plan (see Appendix E or D2L Graduate Programs Student Support site >> Content >> Forms). Students must have a plan, select a teaching experience advisor, and receive approval from their Major Professor. The Teaching Experience Advisor must be a BE Faculty member, not necessarily the Major Professor. A report must be submitted to the internship advisor at the end of the teaching internship. The completed Teaching Experience Plan will be submitted to the appropriate D2L assignment folder.

All PhD students are required to have at least one unit of Teaching, to document their teaching experience. The following are methods to achieve this teaching experience.

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Graduate Teaching Experience Options:
1. BE 693 Internship. Students will serve as a GTA for one semester and enroll in 1 unit under their Major Professor's BE 693 internship section. The GTA Internship must have significant teaching responsibilities.
2. Take FCSC/CALS 596E, 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: This seminar course is designed for graduate students who serve 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 and classroom climate and culture, will be covered.
4. Take IA 697B, Using Technology in Teaching: This seminar 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 the 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://cct.oia.arizona.edu).

7.9   Time Limitation

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

7.10 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 in GradPath no later than the end of the second 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; and
3. Approved Minor courses.

Before submitting their Plan of Study in GradPath, the student must receive approval from their PhD Graduate Committee, Major Professor, Minor Advisor, the BE Director of Graduate Studies, BE Academic Program Manager, and the Graduate College. Courses listed in the POS must match the actual course enrollment/course completion posted in UAccess. Students who make changes to their UAccess course enrollments, after receiving approval for their POS, must modify and submit the POS for reapproval. For more information on the doctoral plan of study, please refer to https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#plan-of-study.

7.11 Research Proposal (Prospectus) for the Dissertation

The Research 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 that satisfies their PhD Graduate Committee. The candidate is

encouraged to include the title of their Research Proposal in their Plan of Study. A draft of the Research Proposal will be completed by the completion of BE 501 (as a course requirement) OR, in the case of Ph.D. candidates already completing BE 501 in their master's degree program, the Research Proposal draft will be completed no later than the end of the 2nd semester in the program. The final Research Proposal will be completed by the end of the 3rd semester in the program. The student uploads the Research Proposal, dissertation title, and in their plan of study to GradPath. Once the final Research Proposal is received in GradPath, the Academic Program Manager will check that the title is correct, and the plan of study meets the departmental requirements and approves the Research Prospectus form in GradPath.

7.12 Comprehensive Examination

Admission to graduate study does not imply admission to candidacy for an advanced degree. Before admission to 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 research and in-depth within the area of specialization. Therefore, the examination should not occur until the student has completed all or almost all their coursework. The exam will determine whether the student will be permitted to continue the PhD program as a BE PhD candidate.

7.12.1 Comprehensive Examination Structure

As per the Graduate College, "Each program determines the format and administration of the written portion. The minor department controls the minor portion of the written examination and may waive it at their discretion." The Comprehensive Examination is considered a single examination and is composed of two parts:

1. **A written exam** covering the major and minor fields. Each committee member decides upon the time allotted to complete the written portion. A student must take and pass the written portion before taking the oral portion and
2. **An oral exam** is to be conducted after taking and passing the written exam. The oral examination is the occasion when faculty committee members have both the opportunity and obligation to require the student to display a broad knowledge of the chosen field of study and sufficient depth of understanding in areas of specialization. Discussion of proposed dissertation research may be included. The oral exam is taken with the candidate's Comprehensive Examination Committee Members And should last for at least an hour but must not last more than 3 hours (as per Graduate College policy). The BE Department recommends that the oral portion is 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. The exact time and place of the oral comprehensive exam must be scheduled with the department and announced in GradPath using the Announcement of Doctoral Comprehensive Exam form before the exam can take place (see Section 7.13.3).
   - NOTE: Students are discouraged from serving food and drinks other than water for their oral defense. Bottled water can be obtained from the department.

7.12.2 Comprehensive Examination Committee and Form

Students should receive verbal approval from their Major Professor and PhD Graduate Committee members before submitting the Comp Exam form in GradPath. The Comprehensive Examination Committee must consist of a minimum of four (4) members. In the BE department, the practice is for the Comprehensive Examination Committee to consist of the PhD Graduate Committee with an additional member(s) and the Major Professor as the Comprehensive Exam Committee Chair. 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. The Graduate College requires the Academic Programs Manager to initiate the Special Member Request [https://grad.arizona.edu/forms/gsas/special-member-request]. Please contact the Academic Program Manager to process the Special Member request. Any members beyond the fourth can also be current tenured or tenure-

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track faculty members or approved special members. Once the GradPath committee form is approved, 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.

7.12.3 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 GradPath form must be approved by the Major Professor, Minor Advisor, BE Director of Graduate Studies, BE Academic Program Manager, and the Graduate College. Once approved, the GradPath will automatically notify the examining committee of the date and time of the Comprehensive Exam.

7.12.4 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. In addition, each committee member completes their program assessment form for the oral comprehensive exam. The Major Professor is responsible for collecting completed assessment forms and submitting them to the Academic Program Manager. These will be compiled for the Academic Program Review.

If the student passes the comprehensive exam, the student will be Advanced to Candidacy and proceed to   complete the PhD Graduate Committee Appointment form.

If the student fails the comprehensive exam, the student is permitted to make a second attempt to pass the examination 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/gsas/degree-requirements/doctor-philosophy] and Policies and Procedures for Oral Comprehensive Examination for Doctoral Candidacy [https://arizona.app.box.com/v/grad-gsas-comporalexam].

7.13 Dissertation Requirements

Students must submit a minimum of two (2) papers for publication. The Dissertation must be submitted to the PhD Graduate Committee for review and approval three weeks before *scheduling the defense*. The student needs to:
1. Be listed as the first author in at least one of the papers.
2. Upload a signed *Journal Article Certification* form.
3. Use a standard style guide (such as the ASABE, Chicago, APA, MLA, or style guide of the journal for which the papers are submitted). See additional guidance in Appendix B.

Dissertation format requirements can be found in Appendix B. BE PhD candidates 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 archived Dissertations are available via the University Libraries [https://libguides.library.arizona.edu/type/theses].

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7.14 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 committee chair, 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 needs to be concluded within three hours. Members of the PhD Graduate 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 one week before the defense date. For more information on the UA's policy on the Final Oral Defense, go to https://arizona.app.box.com/v/grad-gsas-finaldefnsinstr. NOTE: The BE faculty support the UA's policy that all   committee members must be present for the entire examination. Students are discouraged from serving food and drinks other than water for their oral defense. NOTE: bottled water can be obtained from the department.

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

7.14.1 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 the requirements relating to Final Oral Defense is the sole responsibility of the student.

7.14.2 Final Oral Defense Process
The following lists the steps to completing the final oral defense of a student's dissertation. See the Biosystems Graduate Programs D2L site for the Timeline/Checklist (an Excel spreadsheet):
1. Upon completion of the research work, the student writes their dissertation and presents it to their PhD Graduate Committee a final draft (penultimate version) of the dissertation not less than **one month before** the proposed defense date recognizing that the defense date needs to be at least one week before the Graduate College final submission deadline of the semester the student plans to graduate.
2. The Committee decides if they need 1 or 2 weeks to review the dissertation.
3. And after the predetermined interval (at least one week but no more than two weeks), the student sends to their committee the departmental *Final Oral Defense Approval* form (forms are found in Appendix E and BE Graduate Program D2L site in the Forms section). This form indicates that the committee has read the dissertation and believes the student is ready to defend the dissertation.
4. If the committee agrees that the student is ready to defend their dissertation, they signify by signing the *Final Oral Defense Approval* Form. The candidate uploads the completed *Final Oral Defense Approval* form to the appropriate D2L assignment folder.
   - If the PhD Graduate Committee determines that the PhD student is not ready to defend, the Academic Program Manager will decline the Announcement of *Final Oral Defense Approval* form in GradPath and notify the BE Director of Graduate Studies and Department Head of the findings. The Major Professor and the student will send an email notice with the new "Program Completion Date (Graduation Term)" to the Academic Program Manager, the BE Director of Graduate Studies, and the Graduate College Degree Check Advisor.
5. Upload a completed and signed *Journal Article Certification* form to the appropriate D2L assignment folder. Note: PhD candidates are required to publish *at least* 2 journal articles and must be included in the dissertation body or appendices.

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6. After an approved *Final Oral Defense* form is uploaded to the D2L student support site, PhD candidates may schedule the date of their final oral defense.
   - Students should be aware of the submission date for archiving the final approved dissertation before they set their final oral examination date. Students should take into consideration and reserve time for additional revisions/edits that may be assigned at the Oral Defense when scheduling their defense with their committee. Refer to the Graduate College's Dates and Deadlines [https://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines].
7. The student must submit the Departmental PhD Defense Announcement to the appropriate D2L assignment folder.
8. Students are also required to submit your PhD defense announcement form and PhD Defense Committee form in GradPath
9. NOTE: the GradPath Annoucement, signed Final Oral Defense Form, Journal Article Certification, and Department Defense announcement form to the appropriate BE Graduate Program D2L Assignment boxes, at least two weeks prior to their expected defense date.
10. NOTE: students are discouraged from providing food and beverages, except for water, for the oral defense. The department can provided bottled water upon request.

The Academic Program Manager will approve the GradPath Announcement of Oral Defense form, once the approved Journal Paper Certification, Final Oral Defense, and Defense Announcement forms are posted to D2L.

7.14.3   Reporting Results of the Final Oral Defense

After the Final Oral Defense, the candidate's PhD Graduate Committee will determine if the student passed, passed with revisions, or failed. The Committee must follow the Graduate College procedures for the Final Oral Defense located at https://arizona.app.box.com/v/grad-gsas-finaldefnsinstr.

If the student passes the final oral defense without revisions:
1. The student may proceed with the dissertation submission.
2. The Major Professor should submit a Change of Grade Form to the Academic Program Manager and report the results in GradPath.

If the student passed the final oral defense with revisions:
1. The PhD Graduate Committee must determine the date 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 PhD Graduate Committee approves the final corrected revisions, the Major Professor sends an email to the Graduate Auditor and the Academic Program Manager confirming the final results for degree completion and 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 fails the final oral defense, they must contact the Graduate College.

7.15 Dissertation Submission

Following a successful Final Oral Defense:
1. The candidate must submit an approved dissertation in electronic format to the University ProQuest system. For further instructions, refer to the Dissertation/Thesis Submission site at https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#final-oral-defense.
2. In addition, the candidate's Major Professor and PhD Graduate Committee may require copies of the dissertation in electronic format. Check with your Major Professor for any special requirements.

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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.

7.16 Dual Degrees

Dual degree programs allow qualified students an opportunity to earn two degrees with a reduction in the total number of credit hours required by allowing 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.

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APPENDIX A

EXAMPLE OF PLAN OF STUDY FOR THE ACCELERATED MASTER'S PROGRAM (AMP) in BIOSYSTEMS ENGINEERING

Senior Year/1st Year in AMP

Course	Unit	Course	Unit
Fall Semester		Spring Semester	
BE 496A, Seminar in Engr Careers & Professions	1	ENGR 498B (Cross-disciplinary Design)	3
ENGR 498A, Cross-disciplinary Design	3	400-level TECH Elective	3
BE 447/547, Sensors and Controls	3	500-level*, TECH Elective	3
400/500-level (BE) Design Elective	3	Tier 2 ART/HUM	3
AME 324A, Mechanics of Materials	3	BE 501*, Research Methods	2
Tier 2 INDV	3	BE 596B*, Grad Seminar, non-presenting	1
BE 597A*, Academic & Career Prep for Graduate Students	1	ENVS 508*, Technical Writing	3
BE 596B*, Grad Seminar, non-presenting	1		
Total	18	Total	18

*These classes are dual enrolled, are taken during the student's senior year, and meet both the BS and MS course requirements.

2nd Year in AMP

Course	Unit	Course	Unit
Fall Semester		Spring Semester	
BE 596A, Grad Seminar, presenting	1	BE 596A, Grad Seminar, presenting	1
500-level BE Elective	3	STAT 571B	3
500-level TECH Elective	3		
BE 910 (Thesis) or BE 909 (Engineering Report)	3	BE 910 (Thesis) or BE 909 (Engineering Report)	2
Total	10	Total	8

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APPENDIX B

THESIS/ GRADUATE REPORT/DISSERTATION REQUIREMENTS

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Objectives

MS Thesis Option and PhD students are required to submit papers for publication in 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 the thesis/dissertation.

Similar options are available in many European and U.S. 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.

- Each manuscript requires a *Journal Article Certification* signed by the Major Professor. The completed Journal Article Certification form needs to be uploaded to the appropriate D2L assignment folder. NOTE: all forms are found in this manual in Appendix E, Graduate Program D2L support site under Forms, and the BE website.

- The student's Graduate Committee will decide when the dissertation is ready for defense. Students must give a copy of the penultimate dissertation *four weeks* (minimum) before the scheduled defense.

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Recommended Thesis/Dissertation Format

Examples of Sample Pages and formatting guidelines for dissertations and theses can be found on the Graduate College site, https://grad.arizona.edu/gsas/dissertations-theses. All Theses and Dissertations are required to be archived in UA Campus Repository. Typically, the elements of the thesis or dissertation is as follows:

1   Title Page (required format)

2   Committee Approval Page (can be physical approval page using required format OR use Adobe Sign to gather signature)

3   Acknowledgments and Dedication (optional)

4   Table of Contents

    4.1   include all chapters & major sections; if you report sub-sections, be consistent in listing all subsections at the same level

    4.2   List of Figures/Illustrations (from Introduction & Present Study)

    4.3   List of Tables (from Introduction & Present Study)

5   Abstract

6   Chapter 1.   Introduction

    6.1   Explanation of the problem(s), objectives, and uniqueness.

    6.2   The relationship of the manuscripts included and your contribution to each of the manuscripts. The published or publishable work must be logically connected and coherently integrated into the dissertation. Simply binding reprints or collections of publications together is not acceptable as a dissertation in either format or concept.

    6.3   Specify your role in the research and production of the manuscript(s). Where research efforts are part of the larger collaborative project, identify one aspect of the project as your own and demonstrate an original contribution.

    6.4   An overall literature review and background.

7   Chapter 2.   Present Study

    7.1   Overall summary.

    7.2   Overall conclusions and recommendations.

8   Appendices:

    8.1   Manuscript No. 1[1] (required for both theses and dissertations)

    8.2   Manuscript No. 2[1] (required for dissertations, optional for theses)

    8.3   Supplementary materials - Materials such as data tables, additional references, graphs, computer programs, and maps.

    8.4   All appendix pages are part of the single pagination sequence of the thesis/dissertation.

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[1]The first page of 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 the use of copyrighted material should be attached if needed.

Recommended Graduate Report (Non-thesis) Format

Students may choose the graduate report option when:

- the research project is not funded
- the research is limited in scope
- the MS program will be a terminal degree
- the research will not be publishable work, but the industry would/could value the information
- the research is related to a project at their work

Graduate reports shall follow the more traditional thesis format without the requirement of a publishable paper embedded in the thesis. NOTE: Follow Graduate College standard format/style guide throughout the text.

1   Title Page (required format)

2   Committee Approval Page (can be physical approval page using required format OR use Adobe Sign to gather signature)

3   Acknowledgments and Dedication (optional)

4   Table of Contents

   4.1   Include all chapters & major sections; if you report sub-sections, be consistent in listing all subsections at the same level

   4.2   List of Figures/Illustrations (from Introduction & Present Study)

   4.3   List of Tables (from Introduction & Present Study)

5   Abstract

6   Chapter 1. Introduction

   6.1   Explanation of the problem(s), objectives, and uniqueness

   6.2   Justification for the research

7   Chapter 2. Literature Review

8   Chapter 3. Methods and Materials

9   Chapter 4. Discussion of Results

10   Chapter 5. Summary and Recommendations

11   Appendices:

   11.1 Supplementary materials - Materials such as data tables, additional references, graphs, computer programs, and maps.

   11.2 All appendix pages are part of the single pagination sequence of the report.

Standard Style Guides

A standard style guide for use of in-text citations and their associated full citation in the References or Citations List must be used for all reports, theses, and dissertations. Standard style guides include, but are not limited to:

ASABE: https://www.asabe.org/GuideForAuthors
APA: https://apastyle.apa.org/style-grammar-guidelines/references/examples
MLA: https://style.mla.org/works-cited/citations-by-format/
Chicago: https://www.chicagomanualofstyle.org/tools_citationguide.html

Purdue OWL is a great source for APA and MLA style guidelines with examples: https://owl.purdue.edu/index.html

MS Word has a reference manager within the References tool, and you can select from a wide variety of style guides. You can also use a reference manager, such as Medeley (https://www.mendeley.com/reference-management/reference-manager) or Microsoft OneNote (a free personal note-taking management app that includes a reference management system).

Use of Hyperlinks – linking to text, titles, tables, or figures within the document

The use of hyperlinks to access text, titles, tables, or figures within the document is discouraged. If there is a need to use hyperlinks, then the full title or table or figure number must be used just in case the hyperlink becomes broken or if the document is in hard-copy form. For example, when referencing Table 3 in the Appendix, the text would read: "Please refer to Table 3 in the Appendix." And the hyperlink would include the words "Table 3 in the Appendix."

APPENDIX C

TIMELINES/CHECKLISTS FOR COMPLETING THE STEPS IN THE BE AMP, BAT/BE TRADITIONAL MS, AND BAT/BE PhD DEGREES

All timelines/checklists for completing the steps for the BE AMP, BAT/BE Traditional MS, and BAT/BE PhD degree programs are located in the Biosystems Graduate Programs D2L site [https://d2l.arizona.edu/d2l/home/1043691] as Excel spreadsheets (see either the Forms section or respective Program pages). They are optional but highly recommended to help you plan your academic time and meet milestones.

Legend:

Color/Marker	Meaning
Yellow	Meeting
Green	Presentation
Blue	Student Defined
Purple	Submit Progress Report to D2L Assignment folder
Green circle	Review of Progress Report
Red circle	Academic Graduate Plan Review by BE 597A Instructor

Student
Accelerated Masters Program
Degree
Fall Start

Link to Graduate College Important Dates: https://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines

Task	Q0	Q1	Q2	Q3	Q4	Summer	Q5	Q6	Q7	W1-7	W8	W9	W10	W11	W12	W13	W14	W15
Meet Academic Advisor & Director of Grad Studies		Y																
Meet Potential Major Professor(s) and Committee Members		Y	Y															
Select and agree on Major Professor, research project, Committee Members			B	B														
Enroll in BE 501, 596B			B															
Complete Academic Graduate Plan assignment (through Final section) in BE 597A			B															
Academic Graduate Plan Review			●R															
Apply to Graduate School				B														
Develop Course Schedule (with Major Professor), Enter information into GradPath				B	B	B	B											
First Yr Progress Report					P													
First Yr Progress Report Review					●G													
Meet committee and share proposal ideas					Y	Y												
Present Proposal to Committee					G	G												
Research Progress							B	B	B	B								
Meet Committee & Share progress								Y	Y									
Year 2, mid-year Progress Report									P									
Year 2, mid-year Progress Report Review										●G								
Submit draft of thesis/report to committee										B	B							
Meet with graduate committee											G	G	G	G				
Upload Final Oral Defense approval form signed by committee to D2L											B	B	B	B				
Schedule Final Oral Defense with committee											B	B	B	B				
Upload Final Oral Defense announcement to D2L												B	B	B	B	B		
Upload Journal Article Certification form signed by Major Professor (minimum of 1 paper) to D2L															B	B	B	B
Upload Final Progress Report														P				
Final Progress Report Review														●G				
Defense															G	G	G	G
Complete Written Exit Survey																		B
Submit electronic copy of Thesis or Send Report to Academic Program Manager																	B	B
Return Keys, Clean Office, etc.																		B

[Link to MS Program Timeline/Checklist in the BE Graduate Programs D2L site](#)

Legend:

Student	🟨 Meeting	🟦 Student Defined	🟢 Review of Progress Report
MS Program	🟩 Presentation	🟪 Submit Progress Report to D2L Assignment folder	🔴 Academic Graduate Plan Review by BE 597A Instructor
Degree		
Fall Start	Link to Graduate College Important Dates: https://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines	

Timeline (Gantt chart):

Column groups: Yr-1 [S1: Q1, Q2 | S2: Q3, Q4], Summer, Yr-2 [S3: Q5, Q6, Q7 | S4: Q8 = W1-7, W8, W9, W10, W11, W12, W13, W14, W15]

Task	Q1	Q2	Q3	Q4	Summer	Q5	Q6	Q7	W1-7	W8	W9	W10	W11	W12	W13	W14	W15
Enroll in BE 597A, BE 596B	🟦																
Studies	🟨																
Meet Potential Major Professor(s) and Committee Members	🟨	🟨															
Select and agree on Major Professor, research project, Committee Members		🟦	🟦														
Enroll in BE 501, BE 596B		🟦															
Complete Academic Graduate Plan assignment (through Final section) in BE 597A		🟦															
Academic Graduate Plan Review		🔴															
Develop Course Schedule (with Major Professor), Enter information into GradPath			🟦	🟦	🟦												
First Yr Progress Report				🟪													
First Yr Progress Report Review				🟢													
Meet committee and share proposal ideas			🟨	🟨													
Present Proposal to Committee			🟩	🟩													
Research Progress						🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦				
Meet Committee & Share progress						🟨	🟨										
Year 2, mid-year Progress Report							🟪										
Year 2, mid-year Progress Report Review								🟢									
Submit draft of thesis/report to committee										🟦	🟦	🟦	🟦	🟦			
Meet with graduate committee											🟩	🟩	🟩	🟩	🟩		
Upload Final Oral Defense approval form signed by committee to D2L											🟦	🟦	🟦				
Schedule Final Oral Defense with committee											🟦	🟦	🟦				
Upload Final Oral Defense announcement to													🟦	🟦	🟦		
Upload Journal Article Certification form signed by Major Professor (minimum 1) to D2L															🟦	🟦	🟦
Upload Final Progress Report to D2L													🟪				
Final Progress Report Review													🟢				
Defense													🟩	🟩	🟩	🟩	
Complete Written Exit Survey													🟦	🟦	🟦	🟦	🟦
Submit electronic copy of Thesis or Send Report to Academic Program Manager																🟦	🟦
Return Keys, Clean Office, etc.																	🟦

Link to PhD Timeline/Checklist in the BE Graduate Programs D2L site

Legend:

Color/Symbol	Meaning
Yellow	Meeting
Green	Presentation
Blue	Student Defined
Purple	Submit Progress Report to D2L Assignment folder
Green circle	Review of Progress Report
Red circle	Academic Graduate Plan Review by BE 597A Instructor

Student
PhD Program
Degree
Fall Start

Task	Yr-1 S1		Yr-1 S2		Yr-2 S3		Yr-2 S4		Yr-3 S5		Yr-3 S6		nth Yr nth-S		Final Year / Final Semester / Final Quarter								
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15 (W1-7)	W8	W9	W10	W11	W12	W13	W14	W15
Meet committee and share proposal ideas				Meeting	Meeting																		
Present Proposal to Committee				Presentation	Presentation																		
Research Progress					Student Defined	Student Defined	Student Defined	Student Defined	Student Defined	Student Defined	Student Defined	Student Defined	Student Defined	Student Defined	Student Defined		Student Defined	Student Defined	Student Defined				
Meet Committee & Share progress							Meeting		Meeting		Meeting		Meeting										
Second Yr Progress Report						Submit Report																	
Second Yr Progress Report Review							● Review																
Qualifying/Comprehensive									Student Defined	Student Defined	Student Defined												
Third Yr & nth-yr Progress Report											Submit Report		Submit Report										
Third Yr & n-th-yr Progress Report Review												● Review		● Review									
Submit draft of dissertation to committee															Student Defined		Student Defined	Student Defined	Student Defined				
Meet with graduate committee															Presentation		Presentation	Presentation	Presentation	Presentation			
Upload Final Oral Defense announcement to D2L															Student Defined		Student Defined	Student Defined					
Schedule Final Oral Defense with committee															Student Defined		Student Defined	Student Defined					
Upload Final Oral Defense announcement to D2L															Student Defined		Student Defined	Student Defined					
Upload Journal Article Certification form signed by Major Professor (minimum 2) to D2L															Student Defined		Student Defined	Student Defined					
Upload Final Progress Report to D2L																	Submit Report						
Final Progress Report Review																	● Review						
Defense																	Presentation	Presentation	Presentation	Presentation	Presentation		
Complete Written Exit Survey																	Student Defined	Student Defined	Student Defined	Student Defined	Student Defined	Student Defined	Student Defined
Submit electronic copy of Dissertation																						Student Defined	Student Defined
Return Keys, Clean Office, etc.																							Student Defined

APPENDIX D

Biosystems Analytics & Technology Graduate Faculty

To be eligible to serve on a graduate committee in the Biosystems Analytics & Technology program, a faculty member must meet one or more of the following criteria:

1. Tenured/Tenure-eligible departmental Faculty
2. Continuing Status/Continuing-eligible departmental Faculty
3. Career Track departmental Faculty
4. Emeritus status departmental Faculty
5. Members of the Graduate Faculty in Other Programs without an FTE in the departmental IF:
   a. Faculty member has a doctoral degree in analytics, bioinformatics, statistics, computer sciences, or related analytics field or a discipline related to any of the program research focus areas, OR
   b. Faculty currently holds a previously held "courtesy appointment" (i.e., 0% FTE or jointly-appointed position) in BE.

Anyone who does not fit into one of the criteria above will be considered a "Special Member" and must be approved by the Graduate College. See Section 1.2 https://grad.arizona.edu/policies/academic-policies/graduate-faculty-policy.

Biosystems Engineering Graduate Faculty

To be eligible to serve on a graduate committee in the Biosystems Engineering program, a faculty member must meet one or more of the following criteria:

1. Tenured/Tenure-eligible departmental Faculty
2. Continuing Status/Continuing-eligible departmental Faculty
3. Career Track departmental Faculty
4. Emeritus status departmental Faculty
5. Members of the Graduate Faculty in Other Programs without an FTE in BE IF:
   a. Faculty member has a doctoral degree in BE or related engineering field or a discipline related to any of the program research focus areas; OR
   b. Faculty currently holds a previously held "courtesy appointment" (i.e., 0% FTE or jointly-appointed position) in BE.

Anyone who does not fit into one of the categories above will be considered a "Special Member" and must be approved by the Graduate College. See Section 1.2 https://grad.arizona.edu/policies/academic-policies/graduate-faculty-policy.

Biosystems Engineering Graduate Faculty
(Faculty with * May Serve on *Doctoral* Committees as Sole Major Professor/Committee Chair)

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

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

Barreto, Armando, Assistant Professor of Practice, PhD, 2013, University of Arizona. Research and teaching interest in topics related to climate change, water conservation, crop mapping, global vegetation change and phenology.

*Barton, Jennifer, 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, Professor and BE Director of Graduate Studies, 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 Environmental Science, PhD, 1999, University of Arizona. Aquaculture.

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

*Gerba, Charles, Jointly-appointed Professor in Environmental Science, PhD, 1973, University of Miami, Miami, Florida. Environmental microbiology.

*Giacomelli, Gene, Professor and Extension Specialist, PhD, 1983, Rutgers University. Horticultural engineering, energy conversions engineering, bioresource   engineering, greenhouse engineering design, and hydroponic crop production.

*Göltl, Florian, Assistant Research Professor, PhD, 2012, University of Vienna. Computational materials design, design of materials at an atomistic level.

Hall, Caitlyn, Assistant Professor of Practice, PhD, 2021, Arizona State University. Soil and water remediation, bioremediation, ecological engineering, climate change, policy, law, disaster epidemiology,

environmental science communication, water treatment, sustainability, disaster and hazard resilience, civic engagement, environmental justice.

Hooks, Triston, Assistant Professor of Practice, PhD, 2020, New Mexico State University. Controlled environment agriculture. Hydroponic systems, vine and specialty crops, integrated pest management, sustainable substrates and organic hydroponics, effect of light quality on plant phytonutrients, plant physiology and salinity tolerance.

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

*Kacira, Murat, Professor and Director of the Controlled Environment Agriculture Program, PhD, 2000, Ohio State University. Controlled environment agriculture, food,   agricultural, and biological engineering.

*Karanikola, Vasiliki (Vicky), Jointly-appointed Assistant Professor in Chemical and Environmental Engineering, PhD, 2015, University of Arizona. Desalination, membrane filtration, and water treatment.

*Li, Haiquan, Assistant Professor, PhD, 2010, National University of Singapore. Bioinformatics, biological mechanisms, clinical informatics, computer science, data mining, translational bioinformatics, and statistics.

*Lyons, Eric, Jointly-appointed Associate Professor in Plant Sciences, PhD, 2008, University of California, Berkeley. Biosystems analytics, cyberinfrastructure for life sciences, computational systems for genomes, advanced visualization of genomic data.

*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 the 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.

*Pryor, Barry, Professor, Jointly-appointed Professor in Plant Sciences, PhD, 1999, University of California, Davis. Controlled environment agriculture, mycology,   fungal detection, and control.

*Rasmussen, Craig, Jointly-appointed Professor in Environmental Sciences, PhD, 2004, University of California, Davis. Soil forming processes, soil-landscape evolution.

*Recsetar, Matthew "Rex," Assistant Professor, PhD, 2019, University of Arizona. Aquaculture engineering, fish culture, aquaponics, controlled environment agriculture, sustainable food systems, innovative cannabis culture systems.

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

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

Tamimi, Akrum, Assistant Professor of Practice, PhD, 1995, University of Arizona. Water resources, wastewater treatment, irrigation, biosystems engineering, civil engineering, environmental engineering.

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

*Yitayew, Muluneh, Emeritus Professor, 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

THE UNIVERSITY OF ARIZONA
COLLEGE OF AGRICULTURE & LIFE SCIENCES
COLLEGE OF ENGINEERING
Biosystems Engineering

PhD TEACHING EXPERIENCE

The BE 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 BE 693, Teaching Experience Internship, to document their teaching experience. You have six methods from which to choose to meet the teaching experience internship. Methods 1-4 outlined below are classes that you can take, in lieu of signing up for BE 693, to help you learn more about teaching in upper education.

METHODS

1. FCSC/CALS 596E, Learner-Centered Teaching for Online Delivery (1 unit; Fall, Spring). 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.

2. IA 697A, Learner-Centered Teaching (3 units; Fall, Spring). This course provides a foundation in learner-centered teaching. It includes theories of adult learning, approaches to the course and lesson design, techniques to assess learning, and development of reflective teaching practices. It is appropriate for instructors who want to improve their teaching and is required for students in the Certificate in College Teaching program.

3. IA 697B, Using Technology in Teaching (3 units; Fall, Spring). This 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.

4. IA 697G, Universal Design: Inclusive Learning Environments (3 units; Fall, Spring). 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.

5. Complete the Certificate in College Teaching through the Office of Instruction & Assessment (https://grad.arizona.edu/catalog/programinfo/CLTCRTG or http://cct.oia.arizona.edu)

6. Serve as a GTA for one semester – *if the GTA experience has significant teaching responsibilities.*

PROOF OF COMPLETION

Graduate Teaching Experience Option	Proof of Completion
FCSC/CALS 596E	Class grade
IA 697A	Class grade
IA 697B	Class grade
IA 697G	Class grade
Certificate in College Teaching through OIA	Copy of Certificate
GTA, one semester	Assessment by GTA instructor

THE UNIVERSITY OF ARIZONA
COLLEGE OF AGRICULTURE & LIFE SCIENCES
COLLEGE OF ENGINEERING
Biosystems Engineering

PhD TEACHING EXPERIENCE PLAN

Student Name _____ Student ID #_____

Method to Achieve credit for completing the Teaching requirements.

- ☐ BE 693 GTA, one semester*
- ☐ FCSC/CALS 596E (in lieu of signing up for BE 693)
- ☐ IA 697A (in lieu of signing up for BE 693)
- ☐ IA 697B (in lieu of signing up for BE 693)
- ☐ IA 697G (in lieu of signing up for BE 693)
- ☐ Graduate Teaching Certificate

Semester and year the student is expected to complete their teaching experience _____

Student's Signature _____

Date _____

* The following section needs to be completed

Teaching Experience Advisor Name _____

Instructor's BE 693 Section Number (if applicable) _____

Instructor's Signature [_____]   Date _____

THE UNIVERSITY OF ARIZONA
COLLEGE OF AGRICULTURE & LIFE SCIENCES
COLLEGE OF ENGINEERING
Biosystems Engineering

JOURNAL ARTICLE CERTIFICATION

(needs to be completed prior to Final Oral Defense & uploaded to the appropriate assignment folder in the Biosystems Graduate Programs D2L)

As the Major Professor of the Graduate student below, I have read and acknowledge that the journal article(s) submission requirement has been met with the following information:

Student Name: _____

Journal Article 1 Title: _____

Name of Journal Submitted to: _____

Status of Article:
☐ *Published,* ☐ *Submitted,* ☐ *Pending Submission**
(*NOTE: if Pending Submission is selected, please provide expected submission date: _____)

Journal Article 2 Title: _____

Name of Journal Submitted to: _____

Status of Article:
☐ *Published,* ☐ *Submitted,* ☐ *Pending Submission**
(*NOTE: if Pending Submission is selected, please provide expected submission date: _____)

_____   _____

Major Professor   Date

FINAL ORAL DEFENSE APPROVAL FORM

As members of the Graduate Committee, we certify that we have read the Thesis/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
COLLEGE OF AGRICULTURE & LIFE SCIENCES
COLLEGE OF ENGINEERING
Biosystems Engineering

PhD Oral Comprehensive Examination Assessment & Rubrics

Candidate:	Date/time:	Place:
Examining Committee		
Member	**email**	**Pass/Fail**

Note: Please fill this form as soon as the Oral Comprehensive Examination concludes. This form and rubric are used to assess all PhD students after completing their comprehensive examination. The data collected will be used to support our Annual Program Review (APR) to assess Outcome 1, and will provide our unit with the necessary information for adjusting our programs, reinforcing current practices, and/or student performance expectations.

Attribute	1 - Poor	2 - Fair	3 - Good	4 -Very Good	5 - Excellent	Score
General Knowledge						
Depth and breadth of knowledge in the focus area						
Knowledge of Fundamental principles in engineering						
Overall response to questions						
Research literature						
Research purpose						
Research methods						
Research theoretical background						
Total						

Rubric

Scoring will use these guidelines and will consider the student's focus area, fundamental principles in engineering and/or analytics, research field literature, research methods, general theoretical background, and overall answers to questions.

Score	Description
Poor	Very poor answers and knowledge as demonstrated by lack of accurate responses to most of the questions even with some help.
Fair	Limited knowledge as demonstrated by significant difficulties in responding to only few of the questions with some aid.
Good	Adequate knowledge as demonstrated by accurate responses to most questions with some help at times.
Very Good	Accurate answers without difficulties and adequate knowledge as demonstrated by complete responses to most questions without any prompting.
Excellent	Excellent and thorough knowledge as demonstrated by accurate response to all questions.

THE UNIVERSITY OF ARIZONA
COLLEGE OF AGRICULTURE & LIFE SCIENCES
COLLEGE OF ENGINEERING
Biosystems Engineering

Report/Thesis/Dissertation Oral Defense Evaluation Form
01/21/22

Student Name: _____

Title of Report/Thesis/Dissertation: _____

Committee Member: _____ **Date:** _____

Directions:
Evaluate this student's engineering report/thesis/dissertation oral defense of the research with a score between 1 (Poor) and 5 (Excellent) for each of the criteria described below using the attached rubric. Briefly comment on the rationale if your score is less than 5. Submit your completed scoring sheet to the committee chair before leaving the defense.

Score (1 – 5)	Criterion	Comment
	Organization of Oral Defense	
	Presentation Style	
	Presentation Pace	
	Content: Depth	
	Content: Accuracy	
	Use of Visual Aids	
	Responsiveness to Audience	

Report/Thesis/Dissertation Oral Defense Rubric

Criteria	Excellent – 5 pts	Very Good – 4pts	Good – 3 pts	Fair – 2 pts	Poor – 1 pt
Organization	Presentation is clear and logical. Listener can easily follow line of reasoning.	Presentation is generally clear. Few minor points with Confusion.	Presentation is generally clear. Few minor points may are confusing.	Listener can follow presentation with effort. Organization Not well thought out.	Presentation is very confused and unclear. Listener cannot follow it.
Presentation Style	Demonstrates effective presentation skills. Speaker is easy to hear and understand. Good eye contact.	Style is generally appropriate. Listener had no trouble hearing or understanding. Eye contact mostly good.	Style is generally appropriate. Listener had some trouble hearing or understanding. Eye contact is inconsistent.	Presentation is too informal or unprepared. Difficult to hear or understand. Much of information is read. Eye contact is poor.	Presentation is consistently at an inappropriate level. Information is read. Speaker can't be heard or understood. No eye contact.
Presentation Pace	Presentation is a planned conversation, paced for audience understanding.	Speaker's pacing is just about right	Speaker's pacing is somewhat too fast or too slow.	Speaker's pacing is too fast, too slow, repetitive, or skipping important details.	Presentation is far too long or far too short.
Content: Depth	Design, methods, results, discussion, and conclusions are clearly and coherently elucidated. Logical and persuasive agreement between data and conclusions. Impact and implications of results and "where do we go from here" discussed.	Description of project and results is generally clear. Somewhat adequate discussion of what results mean with little missing.	Description of project and results is generally clear. Some discussion of what results mean.	Some components of project description are minimal or missing. Little discussion of what the results mean.	Description of project and results are very difficult to follow. No discussion of meaning of results. Listeners learn little.
Content: Accuracy	Information given is consistently accurate. Facts and calculations are correct.	No significant errors are made. Listeners recognize a few errors are a result of oversight or nervousness.	Some errors are made. Listeners recognize the errors are a result of oversight or nervousness.	Enough errors made to be distracting, but some information is accurate.	Information is so inaccurate that listener cannot depend on the presentation.
Use of Visual Aids	Aids prepared in professional manner. Font is large enough to be seen by all. Well organized. Main points stand out.	Aids contribute, most material supported by aids. Font size is appropriate for reading.	Aids contribute, but only some material supported by aids. Font size is appropriate for reading.	Aids are poorly prepared or used inappropriately. Font is too small. Too much information is included.	No aids are used, or they are so poorly prepared that they detract from the presentation.
Responsiveness to Audience	Responds well to questions. Restates and summarizes when needed.	Generally responsive to questions without prompting.	Generally responsive to questions with some help at times.	Reluctantly interacts with audience. Responds poorly to questions.	Avoids audience interaction. Not responsive to audience.

**Exit Survey for MS and PhD Students Near Graduation in the
Department of Biosystems Engineering**

Each student will complete a written exit survey. The written exit survey is a measure of your perceptions of whether you met the program's educational objectives and other information to help us improve our graduate programs. You can find the written exit survey on the D2L Graduate Programs support website under Forms in Content.