

**Department of Chemical and Environmental
Engineering**

CHEMICAL AND ENVIRONMENTAL ENGINEERING

GRADUATE STUDENT HANDBOOK

2020-21

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1. Introduction

This Graduate Handbook is intended to help you on your path through the Department of Chemical and Environmental Engineering's (the Department) advanced degree programs and on to future career success. Here you will find information and guidance from the time you arrive until you become one of our many outstanding graduates. We strongly recommend that you review the entire document now and ask questions about it. Please be aware that the handbook is likely to be updated each year and that those revisions may be important to you. You should also become familiar with the information provided on the University of Arizona (UA) Graduate College website: <http://grad.arizona.edu/>. Specifically, general information about non-academic resources for graduate students can be found at: <http://grad.arizona.edu/new-and-current-students>.

2. General Program Information

The Department offers the following advanced degrees in both Chemical Engineering (ChE) and Environmental Engineering (EnE): Master of Science (MS) with and without a thesis (MS Thesis and MS Non-Thesis), and the Doctor of Philosophy (PhD). Both programs also offer an Accelerated Master's Program (AMP) leading to an MS Non-Thesis or MS Thesis degree. Students in the MS Non-Thesis degree program will broaden their knowledge in their chosen discipline, and by selecting the MS Thesis program, students will complete a research project working in close collaboration with a faculty member. Students choosing the PhD degree will be trained to do independent and original research.

Graduates of each of these degree programs will be trained to be leaders in industry, academia, national laboratories, or consulting. CHEE graduates are represented in organizations such as Intel, GlobalFoundries, Micron, Cabot Microelectronics, NXP Semiconductors, Arizona State University, and more. Upon graduation, students will be well-prepared to assume positions in a variety of topics due to the diversity of the knowledge gained in the two CHEE degree programs, with the environmental focus leading to more environmentally-relevant positions.

3. Information for New Students

3.1 Assignment of Research Projects and Advisors

The MS and PhD degrees are primarily research degrees. Consequently, one of the most important objectives for entering graduate students is to participate in the processes for determining your research topic and advisor(s). Developing and maintaining an early working relationship with an advisor, who is responsible for mentoring, is extremely important.

Students who have a research assistantship will typically have an advisor before the semester begins. Self-supported students or students with fellowship support, if without an advisor at the beginning of their first semester, must meet with all faculty members that have available research projects during their first two weeks of classes. All meetings with faculty regarding research should be completed within the first two weeks after arrival at the University of Arizona.

After completing these steps, and no later than the Friday of the third week of classes, a new student should indicate their first, second, and third choices for a faculty advisor on the Chemical and Environmental Engineering Advisor Selection Form (see Appendix A6 of this handbook). This form must be submitted to the chair of their respective Chemical Engineering or Environmental Engineering Graduate Studies Committee (GSC) with a copy to Grace Fuller (gracefuller@arizona.edu), the graduate program coordinator. Even if a student has a faculty advisor before the semester begins, the student must complete the form with the name of their faculty advisor and submit it to their respective GSC chair and the graduate program coordinator.

The GSCs for both Chemical Engineering and Environmental Engineering oversee the project requests by incoming students for the respective degree programs. Final assignment of students to projects and research advisor(s) is made for all degree programs by the GSCs and the department chair based on student preferences (see Appendix A6), availability of funding, and balance in accordance with the research objectives of the department. Please see the department chair if you have any questions during these processes.

Students who do not complete these explicit processes for project and advisor selection on time must meet with the GSC for their respective program to discuss the issue. This meeting will take place before the end of the Fall semester of the first year of study and will be set up jointly with the GSC and the student. Without a compelling extension request (see Section 3.11 herein), the GSC will ask the Graduate College to remove a student who has not obtained an advisor by the end of the first semester.

3.2 Reassignment of Faculty Advisor

Although the situation is extremely rare, the department realizes that it is sometimes in the best interest of the student to switch advisors. In such cases, ethical behavior requires that both the student and the new advisor consult with the first faculty advisor before making any such change. To change advisors, the student must obtain approval of the primary faculty advisor or the Director of Graduate Studies for the relevant program (ChE or EnE). Once the approval is obtained, the student will do one of the following:

MS Student

1. If the student has not already completed a Plan of Study, then the student will simply list the new faculty advisor on the Plan of Study at such time as it is submitted to the Graduate College.
2. If the student has already completed a Plan of Study in GradPath, then the student will submit a new Plan of Study with the new advisor listed.

PhD Student

1. If the student has not already completed a Plan of Study, then the student will simply list the new faculty advisor on the Plan of Study at such time as it is submitted to the Graduate College.
2. If the student has completed a Plan of Study but has not completed the Comp Exam Committee Appointment form in GradPath, the student must submit a new Plan of Study with the new advisor listed.
3. If the student has completed the Comp Exam Committee Appointment form in GradPath but has not completed the Oral Comprehensive Exam, then the student must submit a new Comp Exam Committee Appointment form listing the new advisor as the Chair of the Comprehensive Exam Committee.
4. If the student has completed the Doctoral Comprehensive Exam, then the student will list the new advisor as the Chair of the Doctoral Dissertation Committee on the dissertation committee appointment form in GradPath.

In the event that a faculty advisor determines that it is in the best interest of a student to be removed from the advisor's research group, then that faculty advisor shall consult with the program's Graduate Studies Committee members to determine best steps for removing and reassigning the student.

3.3 Satisfactory Academic Progress

A high level of performance is expected of all students in the CHEE graduate degree programs. Students must maintain a minimum of a 3.0 cumulative GPA throughout the program and must consult with both their faculty advisor and the graduate program coordinator to discuss issues pertaining to unsatisfactory progress, which includes conditions resulting in academic probation (<https://grad.arizona.edu/policies/academic-policies/academic-probation>) such as a GPA below 3.0 at the end of a given semester. Students failing to meet GPA requirements will be placed on probation by the Graduate College for one semester. If the cumulative GPA is not raised to the required minimum in the following semester, the student's faculty advisor and the relevant graduate studies committee will decide whether to: (1) academically disqualify the student from the program; or (2) with Graduate College approval, allow the student to continue on probation upon approval of a remediation plan. The student is expected to work with the student's faculty advisor and the graduate program coordinator to improve the student's academic standing.

3.4 Help with Academic Issues

In most circumstances, graduate students should first pose questions on academic matters to their faculty advisor. Other members of their thesis or dissertation committee should also provide guidance and mentoring. The Graduate Studies Committees can help with advice, especially on curriculum questions and deadlines. Students may also contact the department chair at any time concerning issues related to their graduate studies.

3.5 Safety Training

All entering graduate students are required to take safety training. **THIS IS REQUIRED PRIOR TO WORKING ON ANY PROJECT.** The safety training is available online through [Desire2Learn \(D2L\)](#). Students must submit an electronic copy of their completion certificate to their faculty advisor and to the graduate program coordinator, Grace Fuller (gracefuller@arizona.edu), upon completion of the course.

3.6 University Policies

Students are responsible for being aware of the policies described at the following websites pertaining to academic conduct, conduct of research, and general student conduct.

- Academic Integrity: <http://deanofstudents.arizona.edu/codeofacademicintegrity>
- Responsible Conduct of Research: <http://www.orcr.arizona.edu>
- Student Conduct: <https://public.azregents.edu/Policy%20Manual/5-308-Student%20Code%20of%20Conduct.pdf>

- Graduate Policies and Procedures: <https://grad.arizona.edu/policies>

3.7 Departmental Graduate Seminar

All full-time graduate students enrolled in the chemical engineering or environmental engineering graduate programs are required to register for 1 seminar unit (CHEE 696A) and attend the departmental seminar or colloquium each semester **unless it conflicts with another required course**. (Enrollment will not be waived for conflicting elective courses.) In rare instances, a student may obtain permission to enroll in both CHEE 696A and a concurrent course (see Section 3.11 herein regarding waivers), but the student must log in to view the Zoom recording of the seminar each week and complete the assignments on time. CHEE 696A is required even if the student has satisfied the seminar requirements for their degree.

3.8 Research and Teaching Assistantships and Other Funding Opportunities

Teaching and research assistantships, traineeships, and fellowships provide the most common forms of support for graduate students. Assistantships at 0.50 full time equivalent (FTE) or higher include a stipend, health insurance, and full tuition. Assistantships at less than 0.50 FTE include a stipend, health insurance, out-of-state tuition, and 50% of in-state tuition: <http://grad.arizona.edu/financial-resources/ua-resources/employment/GA>.

Research assistantships (RAs) are awarded to graduate students by faculty advisors and funded by the faculty advisor's research program. Priority is given to PhD candidates. RA contracts may be for 0.25 FTE, 0.33 FTE, or 0.50 FTE. The faculty advisor is responsible for supervising RAs whom they employ.

Teaching assistantships (TAs) are awarded/assigned by the GSC each semester. Priority is given to 2nd–5th year PhD students. ***Note that it is strongly recommended that all PhD students TA at least one semester during pursuit of their degree.*** All students must have the appropriate background for the course for which they will TA (e.g., they have taken an equivalent course as an undergraduate), and they must pass the Graduate College's Teaching Assistant Online Training and Orientation (TATO) test. TA and grader position descriptions typically are provided to all graduate students during the semester preceding the semester where the TA or grader is needed. Interested students must submit a resume to the graduate program coordinator and indicate which position interests them. The TA positions consist of academic training intended to provide the student with the opportunity to participate in the education of undergraduate students. Duties may include conducting laboratory and discussion sessions and holding office hours. FERPA training is required for all TA positions. Further information regarding FERPA requirements can be found at: <http://registrar.arizona.edu/personal->

[information/ferpa-tutorial](#). TAs are supervised and reviewed by their assigned course instructors. The review process is mandatory and provides constructive feedback for the TAs.

Out-of-state tuition is waived with all RA and TA contracts.

RAs and TAs receive partial or full in-state tuition coverage as part of their employment benefit as follows:

0.25 FTE: 50% in-state tuition covered

0.33 FTE: 50% in-state tuition covered

0.50 FTE: 100% in-state tuition covered

Students awarded less than 0.50 FTE are responsible for payment of 50% of their in-state tuition. For specific information on tuition costs, students can refer to the online Tuition Calculator at <https://tuitioncalculator.fso.arizona.edu>.

Students who are awarded TA/RA positions will receive an offer letter outlining their specific funding, including tuition coverage at 50% or 100%, prior to the beginning of the semester in which they will serve as a TA/RA. One important requirement prior to serving as a TA/RA is to complete online training in Title IX (<https://equity.arizona.edu/training/online-training>).

Graders are hired as needed for core chemical engineering and environmental engineering courses. PhD and MS students with appropriate background for the course are eligible to apply for grader positions. Graders are hired on an hourly basis for no more than 5 hours per week during the semester. There is no tuition coverage or health insurance benefits with grader contracts.

Graduate students may seek additional funding opportunities announced by the UA Graduate College. A detailed listing is available at: <https://grad.arizona.edu/funding/opportunities>. Graduate students seeking funding for their studies or research can also find helpful information through the [Office of Fellowships and Community Engagement](#). Many other funding resources are available to UA students through [Scholarship Universe](#). The Graduate and Professional Student Council (GPSC) also has funding opportunities at <https://gpsc.arizona.edu/grantsawards>.

One of the scholarships that may be given by the UA Graduate College is the [Thesis & Dissertation Tuition Scholarship](#) for non-resident students who are within two years of completing their degrees and are taking only

900-level graduate courses. The scholarship can reduce tuition for these students to the in-state resident amount. If you are interested in taking advantage of this scholarship, please contact Grace Fuller (gracefuller@arizona.edu), the graduate program coordinator, as it requires a department nomination.

3.9 Other Resources

The Graduate College offers students a number of resources for parents, for professional development, for health and wellness, and more. Information on the many resources available can be found at <https://grad.arizona.edu/new-and-current-students>.

3.10 Degree Requirements, Timelines and Deadlines

There are five graduate degrees offered by the Department of Chemical and Environmental Engineering: PhD in Chemical Engineering, MS in Chemical Engineering, PhD in Environmental Engineering, MS in Environmental Engineering and, beginning in 2021-22, an ME in Environmental Engineering. Subsequent sections describe the particular requirements for each of the first four degree paths. The student's faculty advisor, other members of their committee, the members of the graduate studies committees, and the staff graduate program coordinator are all sources of additional information regarding the department's degree requirements and deadlines. The staff graduate program coordinator is probably the student's most reliable source. The graduate program coordinator helps the student navigate required forms, timelines and deadlines so that the student can graduate on time. There are degree checklists in the Appendices (A3–A5) of this handbook that students should review and keep with them during their full period of study to make sure they are on track.

Graduate studies milestones indicating the semesters in which certain administrative steps should take place in order to meet satisfactory progress towards completion of degree requirements are highlighted in yellow on the many Sample Plans provided in the following sections of this handbook. These steps include comprehensive exams, submission of research proposals, and timely filing of required forms (e.g., plan of study, committee appointments, etc.). The graduate program coordinator reviews student progress regularly and will often provide reminders to students who have fallen behind on progress, but it is still the student's responsibility to be aware of and adhere to the degree requirements, timelines and deadlines required for their degree. Students who fail to make satisfactory academic or research progress will be notified in writing of their status. They will be asked to develop and submit a remediation plan signed by their faculty advisor. It is in the best interest of both the students and the Department of Chemical and Environmental Engineering for degrees

to be earned in a timely manner. MS students who have not completed degree requirements within 4 years, or PhD students who have not completed degrees within 6 years will receive a letter strongly encouraging them to complete all degree requirements within 1 year (with a copy to the Graduate College). Students who fail to meet this deadline will be sent another letter (with a copy to the Graduate College) and will be required to submit a letter requesting and justifying a time extension to the relevant graduate studies committee (with a copy to the graduate program coordinator) no later than 1 month after receipt of the CHEE letter. A letter of endorsement from the faculty advisor and the student's advisory committee (whether thesis or dissertation) must accompany the student's letter of request. This process can be repeated once more before the student is judged to be in noncompliance with timely progress. If extreme extenuating circumstances prevent a student in good standing (e.g., $GPA \geq 3.0$) from completing the degree requirements within the year, a leave of absence may be requested. Students who fail to complete requirements and fail to submit a letter requesting a time extension will be judged to be in chronic non-compliance, and the Graduate College will be asked to dismiss the student from the CHEE program. Dismissed students are eligible to reapply to the program; however, reapplication does not guarantee readmission.

Specific information about steps to the degree can be obtained from the Graduate College website, which includes a list of official requirements, deadlines and procedures. Students must follow the specific instructions provided at the following links:

- <http://catalog.arizona.edu/>
- <https://grad.arizona.edu/gsas/degree-requirements>

All PhD and MS students must submit GradPath forms to the Graduate College electronically. Students must review the Graduate College information carefully and be cognizant of deadlines. From the website listed in the second bullet above, students can navigate to find the following two links that provide important information about dates/deadlines, as well as find resources for parents, professional development, and health/wellness:

- <http://grad.arizona.edu/new-and-current-students>
- <http://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines>

3.11 Department Waivers and the Appeals Process

Any student who wishes to request a departmental waiver for any of the department's degree requirements, for either MS or PhD degrees, must complete a Graduate Student Department Petition (see Appendix A9) and

submit it to the appropriate Graduate Studies Committee Chair. The request will be reviewed by the program's Graduate Studies Committee. The request must be supported by a compelling case or the petition will be denied. Additional pages can be attached and submitted with the petition, if necessary. NOTE: The petition must be submitted in the semester for which a change is being requested or it will be automatically denied. A student who is denied a waiver may, at the discretion of the student and with the support of the student's faculty advisor, appeal to the Department Chair for additional review of the case. Weighing discussions with the student, the student's faculty advisor and the relevant Graduate Studies Committee members, the decision of the Department Chair will be considered final.

3.12 CHEE Incomplete Policy

Students earning a grade of Incomplete, "I," for a course must submit a completed [Report of Incomplete Grade form](#) to the CHEE graduate program coordinator for inclusion in their academic record. Incomplete grades should be completed in a timely manner and are submitted at the discretion of the course instructor. Any Incomplete grade must be completed no later than one year from the last day of the term of the course for which the student received the incomplete unless a one-year extension has been approved by the student's instructor and the Graduate College dean prior to the one-year deadline.

3.13 Annual Evaluation

All CHEE graduate students will be evaluated at least annually with regard to satisfactory progress toward completing their degree requirements. TAs and RAs will receive official performance reviews, copies of which will be filed with the department through the Graduate Program Coordinator.

3.14 Transitioning from MS to PhD or adding an MS to a PhD program

On the advice of the student's faculty advisor, a master's student who is in good academic standing (GPA of 3.0 or higher) may transition to pursue a PhD. The student must apply and be accepted to the doctoral program through GradApp (and pay the application fee). It is strongly suggested that the faculty advisor be selected as a reference for the PhD application. The reference letters used for the master's application may also apply to the PhD, but the applicant will need to see Grace Fuller (gracefuller@arizona.edu), the graduate program coordinator, for information on how to navigate the application form to satisfy the references requirement.

Students who transition from the MS program to the PhD program are expected to take the Qualifying and Comprehensive Examinations on the same schedule as if their first day in the MS program was their first day in the PhD program. If the student transitioning to the PhD has a GPA of 3.75 or greater in their program's

core courses, they will be exempt from taking the Qualifying Exam. If the student transitioning to the PhD has a GPA below 3.75 in their program's core courses, the student must take the exam on the next available exam date after having completed the core courses. See Sections 4.1.4 (Chemical Engineering) and 5.1.3 (Environmental Engineering) for additional details.

A student may also determine, upon the advice of the student's faculty advisor, to add an MS degree in the student's same respective program to the student's PhD program. To add the MS to the PhD program, the student must complete a Change of Program Form to be signed by the student and the program's Graduate Studies Chair. The completed form must be submitted via email to the CHEE degree counselor at the Graduate College. Grace Fuller (gracefuller@arizona.edu) can provide a copy of the form to the student. The student does not need to apply for the MS or pay an application fee.

3.15 Graduate Student Academic Grievance Procedures

A student with any type of grievance should first communicate with their graduate research advisor or chair of the Graduate Studies Committee, based on which is more appropriate in the student's view based on the matter at hand. This process aims to resolve grievances informally within the department. When issues cannot be resolved informally, the graduate student is encouraged to read the Grievance Policy of the University of Arizona Graduate College: <https://grad.arizona.edu/policies/academic-policies/summary-grievance-types-and-responsible-parties>.

3.16 International Student Requirements and Resources

Information specific to international students can be found on the Graduate College website:

- <https://grad.arizona.edu/international-students>

International students can also find resources specific to their needs at the International Student Services Office:

- <https://global.arizona.edu/international-students>

4.0 Degree Requirements: Chemical Engineering

| | PhD* | Thesis MS | Non-Thesis MS |
|---|--------|-----------|---------------|
| Required Courses (CHEE 502, 505, 506, 530)** | 12 | 12 | 12 |
| Electives (excluding minor) | 6 | 9 | 9 |
| Minor *** | 9-12 | | |
| CHEE 696A (Graduate Seminar) | 6 **** | 4 **** | 2 **** |
| CHEE 910 (MS Thesis) | | 5 | |
| CHEE 909 or CHEE 594 and 1 unit of CHEE 909 (MS Non-thesis) | | | 3 |
| CHEE 900 (Research) | 12 | | 4 |
| CHEE 920 (Dissertation) | 18 | | |
| <i>Total Units</i> | 63-66 | 30 | 30 |

* Students who enter the PhD program with an MS in Chemical Engineering or equivalent may transfer course work as part of the requirements for the PhD according to regulations stipulated by the Graduate College and approval by the Chemical Engineering GSC.

** Required core courses are offered only once per academic year, either in the Fall or the Spring. Students must be aware of this when they are planning their studies.

*** Different departments have different minor unit requirements. If the PhD minor requires more than 9 units of minor coursework (e.g., 12 units), the student will meet the 36 unit minimum in major coursework and will therefore complete their degree with more than the 63 Graduate College required minimum units. Students should work with the graduate program coordinator to make sure that they take the required number of major units. The Graduate College also requires that at least 22 units of the combined major and minor units must be graded units (i.e., A/B)

**** Note that all CHEE graduate students must register and regularly attend CHEE 696A (Graduate Seminar) each semester that they are in their respective programs. However, PhD students' Plans of Study should include only the number of units listed in the table above to meet Graduate College requirements and allow the student to advance to candidacy after completion of the Comprehensive Exam.

The Graduate College website summarizes graduate degree requirements at: <https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy>. For more information about the Accelerated Master Program (AMP) leading to the Thesis or Non-Thesis MS degree, you may refer to Section 4.3 of this handbook.

Descriptions for the courses shown in subsequent pages can be found at <https://chee.engineering.arizona.edu/grad-programs/courses>

4.1 PhD Program (Chemical Engineering)

Thirty-six (36) units of coursework are required for the major subject, exclusive of dissertation research and the minor. Six (6) units of seminar (CHEE 696A), 9 units of electives (which may include additional units of CHEE 900), 12 units of CHEE 900 and 18 units of dissertation (CHEE 920) will be used to satisfy Graduate College requirements for the PhD degree, as well as the core courses outlined below and 9-12 units of minor courses (depending on the requirements of the minor department).

4.1.1 Course Requirements for Chemical Engineering (ChE) PhD

All Chemical Engineering PhD students are required to take the following core courses at the UA or an approved equivalent elsewhere:

- CHEE 502—Advanced Engineering Analysis
- CHEE 505—Advanced Chemical Engineering Transport Phenomena
- CHEE 506—Advanced Chemical Engineering Thermodynamics
- CHEE 530—Chemical Reaction Engineering

Additionally, Chemical Engineering PhD students will take a minimum of 6 units of electives (excluding units for their minor courses), a minimum of 6 units of CHEE 696A (Graduate Seminar)* to meet Grad College unit requirements, 12 units of CHEE 900 (Research), 18 units of CHEE 920 Dissertation Research, and 9-12 units of a minor. Students who enter the PhD program with an MS may transfer up to 30 units of coursework after approval from the Graduate College, and will be evaluated individually to devise a Plan of Study (see Section 4.1.6 herein). Note that unit requirements for minors can vary by department. According to the Graduate College, if the student minors in a subject that requires more than 9 units of coursework, the student will still need to take a full 36 units of major coursework outside of dissertation units that must be reflected on the submitted Plan of Study (see Section 4.1.6 herein).

* Units listed are to allow students to meet Graduate College unit requirements and advance to candidacy after completion of their Comprehensive Exam, but the Department of Chemical and Environmental Engineering requires students to register for and regularly attend the Graduate Seminar each semester that they are in the CHEE program.

4.1.2 Sample Course Plan—Chemical Engineering PhD

The following table is to be used as a **general guide only**—please work with your faculty advisor and the graduate program coordinator to determine your own individualized Plan of Study (see Section 4.1.6). Specific course requirements are outlined in Section 4.1.1 above.

| | Fall | Spring |
|---------------|--|---|
| Year 1 | CHEE 502—Advanced Engineering Analysis (3) CHEE 505—Advanced Chemical Engineering Transport Phenomena (3) CHEE 506—Advanced Chemical Engineering Thermodynamics (3) CHEE 696A—Graduate Seminar (1) CHEE 900—Research (3) <i>Student should have an assigned research advisor by end of this semester.</i> | CHEE 530—Chemical Reaction Engineering (3) Elective (may include additional units of CHEE 900) or minor (3) CHEE 696A—Graduate Seminar (1) CHEE 900—Research (3) <i>Any student with a GPA <3.75 in the four core courses (502/505/506/530) must take the written qualification exam in August. The exam is waived for GPA ≥ 3.75.</i> |
| Year 2 | Elective (may include additional units of CHEE 900) or minor (3) Elective (may include additional units of CHEE 900) or minor (3) CHEE 696A—Graduate Seminar (1) CHEE 900—Research (3) <i>The student's Plan of Study is due by the end of the third semester.</i> <i>Student works with their Faculty Advisor to determine their Graduate Committee by the end of their 3rd semester in the program. Submit Comp Exam Committee Appointment form in GradPath when Graduate Committee is determined.</i> | Elective (may include additional units of CHEE 900) or minor (3) Elective (may include additional units of CHEE 900) or minor (3) CHEE 696A—Graduate Seminar (1) CHEE 900—Research (3) <i>Determine Comp Exam date and file Announcement of Doctoral Comp Exam Form in GradPath before end of semester.</i> <i>All students must take the Comprehensive exam: (i) write their thesis proposal; and (ii) orally defend their thesis proposal no later than September of the next fall semester.</i> |
| Year 3 | CHEE 696A*—Graduate Seminar (1) CHEE 920—Dissertation Research (4) <i>Students who have passed the Comprehensive exam should plan to TA at least one semester.</i> | CHEE 696A*—Graduate Seminar (1) CHEE 920—Dissertation Research (4) <i>Students will advance to candidacy as soon as they have completed all major and minor coursework on their Plan of Study, as well as the Comprehensive Exam.</i> |
| Year 4 | CHEE 696A*—Graduate Seminar (1) CHEE 920—Dissertation Research (5) | CHEE 696A*—Graduate Seminar (1) CHEE 920—Dissertation Research (5) |

* Candidates wishing to advance to candidacy immediately following their Comprehensive Exam cannot have any outstanding non CHEE 920 units listed on their Plan of Study or they will not advance until they complete those units. Therefore, while required by the department, these courses cannot be listed on the Plan of Study if they are to be taken after the Comprehensive Exam.

** Although 18 units of CHEE 920 are required for the PhD degree, more units are suggested if a student needs to maintain full-time status of 9 units per semester.

4.1.3 CHEE 900 Research Requirement

During the first and second year of the student's progress toward their PhD degree, the student will take CHEE 900 Research, 3 units each in their first and second semesters, and 3 units each in their third and fourth semesters, as they develop individual research that may lead to their dissertation thesis. Students may also opt to take additional CHEE 900 units for their required elective units for an additional 6 units (e.g. 6 units each in their third and fourth semesters instead of 3). Students who enter the PhD program after completing a Master's in Chemical Engineering at the University of Arizona may need fewer CHEE 900 units at the discretion of their faculty advisor. Nonetheless, students must take CHEE 900 until they complete their oral Comprehensive Exam and should take CHEE 920 after that. Note that this is not specific dissertation research but a time of exploration as the student hones planning, concepts and goals. Note that CHEE 900 should not be used directly for dissertation preparation. CHEE 920 is reserved for dissertation preparation. Beginning in the third year (or fifth semester), students should begin registering for CHEE 920.

4.1.4 Qualifying Examination

The PhD Qualifying Examination is a written exam, given in August of the 2nd year before the semester starts. The exam is given over two days and the subjects evaluated are Transport Phenomena, Thermodynamics, Reaction Engineering, and Applied Mathematics. The material evaluated will be taken from the core graduate Chemical Engineering courses. The written qualifying exam is waived for students with a GPA of 3.75 or greater in the core courses CHEE 502, 505, 506 and 530 (or equivalent transferred credits). Students taking the Qualifying Exam will take the sections of the exam that apply to subjects for which they did not receive a grade of "A." Students failing section(s) of the exam will retake the exam for that (those) section(s); the retake exam will be offered December of the same year the exam is initially taken. If the student fails any part of the exam again, then the student will have failed the written qualification exam, will be placed on the MS track and is ineligible to reapply for a PhD in Chemical Engineering at the University of Arizona.

For international transfer students and those students entering with a degree other than chemical engineering, the GSC will work with the student to develop a Plan of Study (see Section 4.1.6) that will prepare them for

the Qualifying Exam at the beginning of their second year. Transfer students from United States universities and those entering with an MS degree in Chemical Engineering will be evaluated individually to devise plans for courses and the Qualifying Exam.

Students who transition from the UA Chemical Engineering MS program to the PhD program are expected to take the Qualifying and Comprehensive Examinations on the same schedule as if their first day in the MS program was their first day in the PhD program. Such students will take the Qualifying Exam on the first date that it is offered after entering the program if they have already completed the four core Chemical Engineering courses. Students who transition to the PhD program with a GPA of 3.75 or above in the four core Chemical Engineering courses are exempt from the Qualifying Exam.

4.1.5 Choice of Minor

All PhD students must fulfill the requirements for a minor in a program of their choice. Selection of the minor should be compatible with the student's research interests and discussed with their research advisor. Students may, at their discretion and upon the advice of their faculty advisor, minor in Chemical Engineering. Minors are administered and approved by the minor department. They typically consist of 9 to 12 units of course work. Because of Graduate College requirements, these units are not part of the 6 elective units mentioned in the Course Requirements Section of this Handbook (Section 4.1.1 above).

4.1.6 Plan of Study

In conjunction with the student's faculty advisor, each PhD student is responsible for developing a Plan of Study to be filed with the Graduate College using GradPath <https://grad.arizona.edu/gsas/gradpath> during their third semester of study, sometime after passing the qualifying examination. The Plan of Study identifies (1) courses the student intends to transfer from other institutions; (2) courses already completed at The University of Arizona that the student intends to apply toward the graduate degree; and (3) additional course work to be completed in order to fulfill degree requirements.

Note, however, that students should not list more than 6 units of CHEE 696A on their Plans of Study even though the department requires that they register and attend the seminar each semester (see Section 3.6 herein). The Graduate College requires that only dissertation units (CHEE 920) be left to complete on the Plan of Study in order for the student to advance to candidacy following successful completion of the oral and written Comprehensive Exam (see Section 4.1.7 below). Therefore, the student must register and attend the Graduate Seminar each semester following the Comprehensive Exam, but they cannot have any outstanding non-

dissertation requirements listed on their Plan of Study or they will be prevented from advancing until they complete those units.

Students are encouraged to meet with the Graduate Program Coordinator to review the proposed Plan of Study before submitting it in GradPath in order to correct inadvertent errors that will prevent its Graduate College approval or prevent them from advancing to candidacy after they successfully complete their Comprehensive Exam. The Plan of Study must have the approval of the student's faculty advisor and chair of the GSC before it is submitted to the Graduate College. Students are responsible to be aware of the deadline to submit the GradPath Plan of Study for review.

4.1.7 Comprehensive Examination

Before admission to candidacy for the doctoral degree, the student must pass both a written and an oral Doctoral Comprehensive Examination. These examinations are intended to test the student's comprehensive knowledge of the major and minor subjects of study, both in breadth across the general field of study, and in depth within the area of specialization. The Comprehensive Examination is considered a single examination, although it consists of written and oral parts. The committee that will evaluate the comprehensive examination will consist of the dissertation committee (as described in Section 4.1.9 herein) and at least one University of Arizona faculty from the chosen minor. Committee members from other programs and institutions can be incorporated in addition to CHEE faculty and minor members as a courtesy and/or as special members. Special members must be approved by the program and the Graduate College for inclusion on the comprehensive exam committee (and dissertation committee, if desired). The student and the student's faculty advisor form the thesis committee in consultation (if needed) with the GSC. Before scheduling the exam, all students must file the Comprehensive Exam Committee Appointment Form in GradPath. Once a date has been determined for the Oral Comprehensive Exam, the student must file an Announcement of Doctoral Comprehensive Exam Form in GradPath.

The written part of the Comprehensive Examination must be completed during the spring semester following completion of the Qualifying Examination (i.e., fourth semester). The written part of the Comprehensive examination will be a research proposal that will be prepared in any US Federal Agency format (greater than 5 pages exclusive of references) recommended by the student's faculty advisor/Comprehensive Exam committee.

The student may also choose to take CHEE 503 (a CHEE elective) to assist them with writing their written proposal, which is a course that focuses on oral and written communication. Students who opt to take CHEE 503 must take the course and complete the proposal by the end of their fourth semester in residency. If a student does not submit a thesis proposal by the end of this semester, they will receive a failing grade in CHEE 503. The student's entire thesis committee will evaluate the written proposal.

The oral part of the Comprehensive examination will be a defense of the thesis proposal (the students will provide this written proposal to their committee at least 2 weeks before their oral exam) in which the student must demonstrate breadth of knowledge in chemical engineering and their minor field of study. The oral part of the examination **must** be completed before September 30 of the fall semester following completion of the written part of the exam (i.e., fall semester of third year). Students should be aware that they need to complete most of their graded coursework (i.e., the 22 graded units of core and elective courses, as well as the minor courses) to be eligible to take the comprehensive examination. Recall that these graded units (A/B system) are composed of the core CHEE courses (502, 505, 506 and 530), the minor courses, the Graduate Seminar (CHEE 696A) and, possibly, elective courses. The student must have completed their courses for the minor in order to take the Oral Comprehensive Exam. The examination is conducted by the student's Comprehensive Examination Committee. The student must display a broad knowledge of the chosen field of study and sufficient depth of understanding on the major and minor fields to pass this exam. Discussion of proposed dissertation research may be included. The examining committee must attest that the student has demonstrated the professional level of knowledge expected of a junior academic colleague. The Graduate College allows no more than one re-take of the oral comprehensive exam.

When the student has passed the written and oral portions of the Comprehensive Examination, and the Graduate Student Academic Services Office (within the Graduate College) has confirmed completion of all non-dissertation units listed on the approved doctoral Plan of Study, the student will advance to doctoral candidacy.

4.1.8 Timeline for Comprehensive Examination and Requirements

According to the Graduate College, the written and oral portions of the comprehensive examination should take place at least six months prior to the Final Oral Examination (defense of dissertation), and they must be completed no less than 3 months ahead of the oral defense of the dissertation. CHEE department requirements are stricter: the written and oral portions of the comprehensive exam **must** be completed by the end of the fall semester of the student's third year (assuming a re-take, by September 30 otherwise) **and** at least 12 months

prior to the defense of the dissertation. The Oral Comprehensive Examination is performed upon successful completion of the written portion of the Comprehensive Exam as outlined in Section 4.1.7 herein. The exact time and place of the oral comprehensive examination must be scheduled with the department and approved in GradPath using the Announcement of Doctoral Comprehensive Exam form before the exam can take place.

In summary, to satisfy the requirements of the Comprehensive Examination a student must:

- File a Plan of Study with the Graduate College through GradPath (as approved by the Graduate Studies Committee)
- Satisfy all requirements stipulated by the minor department or program
- Complete all required courses, and a minimum of 90% of *all* coursework
- Complete the Written Comprehensive Examination as described above
- Take and successfully pass the Oral Comprehensive Examination as described above

4.1.9 Dissertation Committee

When the student has an approved doctoral Plan of Study on file and approved in GradPath, has satisfied all graded course work on their Plan of Study with the possible exception of CHEE 696A, all requirements of their minor department, and passed the written and oral portions of the Comprehensive Examination, the student must select their Doctoral Dissertation Committee. The Doctoral Dissertation Committee must include a minimum of three members, all of whom must be University of Arizona tenured, tenure-track, or approved as tenure-equivalent for the purposes of serving on graduate committees. It must include the student's dissertation director (faculty advisor) and two other members of the Chemical and Environmental Engineering Department faculty. Additional committee members may include eligible members of the CHEE department or the candidate's minor department, other UA department faculty, or a specially approved member from outside the UA faculty.

Once the committee is selected, the student must submit the Doctoral Dissertation Committee Appointment Form in GradPath. The Committee Appointment form reports the student's planned dissertation committee, dissertation title (subject to change), and the expected graduation term. It requires approval from the student's dissertation director (faculty advisor) and the major and minor departments. The approval signature from the minor department on this form indicates both approval of the reported dissertation committee and confirmation that the student has satisfied all requirements for the minor.

Any changes to the committee should be reported to the Graduate Student Academic Services office. Under normal circumstances, submission is expected at least one year before the Final Oral Examination (i.e., defense

of dissertation). If a change in committee composition is required within the one year window, please report it to your program's Graduate Studies Committee as soon as possible so that a suitable replacement can be appointed.

4.1.10 Annual Interaction with Dissertation Committee

The overall goal is for students to complete their PhD degrees in four years. Hence, in the years after Completion of the Comprehensive Examination (years 3 and 4), all PhD candidates must, as part of their CHEE 920 Dissertation credits, meet with their Doctoral Dissertation Committee as described in Section 4.1.9 above, each spring semester in years 3 and 4. The Dissertation Committee will evaluate the intellectual content of the student's proposed project and progress. The meeting will consist of an oral presentation given to the committee. The presentation should review progress to date and, in particular, should include a discussion of publications that will be submitted or are in progress (see Section 4.1.12 herein). The committee members will be required to sign the Annual Dissertation Committee Review form (Appendix A7) and the student must return the signed copy to Grace Fuller.

4.1.11 Final Oral Defense Examination

Upon the completion and successful approval of the dissertation research by the dissertation committee, the candidate is to submit to a Final Oral Defense Examination. A copy of the signed cover page of the dissertation document must be submitted to the GSC. The examination focuses on the dissertation itself, but it can also include general questioning related to the field(s) of study within the scope of the dissertation. The examining committee will be the same as the dissertation committee previously described in Section 4.1.9 above. Committee members representing the minor program must be invited to the defense, but their participation is optional. There will be a public facing presentation as part of the candidate's defense, but the questioning of the candidate by the dissertation committee is closed to the public. The candidate must submit an announcement of their final Oral Defense via GradPath at least two weeks before their defense. If the defense will be conducted by Zoom or other online platform, the candidate must also provide the link to the online defense to the Graduate Program Coordinator (Gracefuller@arizona.edu) so that the public portion of the defense can be announced to the Department of Chemical and Environmental Engineering. Additional information on the dissertation defense may be found at <https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#final-oral-defense>. Note that, beginning in Spring 2020, all dissertation approval pages must be completed through AdobeSign. Students must work with the Graduate Program Coordinator to get the approval page drafted and set up for signature.

4.1.12 Publications

Having multiple publications successfully submitted while still in graduate school greatly enhances the student's potential for landing either a faculty position at an accredited university or a research position at a major corporation. Therefore, prior to graduating, PhD students are strongly encouraged to have two first-author publications either accepted, in press or published in peer-reviewed, indexed journals. These publications should form a major part of the student's dissertation. Copies of any publications must be submitted to the Graduate Program Coordinator for delivery to the chair of the Graduate Studies Committee and the department chair, along with the Publications Form (see Appendix A8, but also available in the department's office), before the final oral examination is scheduled. A successful submission of a manuscript to a peer-reviewed journal can be counted as a publication on the publications form. When a publication has been accepted by a peer-reviewed, indexed journal, email the citation to the Graduate Program Coordinator for department records.

4.2 MS Program (Chemical Engineering)

All Chemical Engineering MS students are required to take the following courses at the University of Arizona or an approved equivalent elsewhere:

- CHEE 502—Advanced Engineering Analysis
- CHEE 505—Advanced Chemical Engineering Transport Phenomena
- CHEE 506—Advanced Chemical Engineering Thermodynamics
- CHEE 530—Chemical Reaction Engineering

There are two MS degree options:

Thesis MS Students

The thesis MS track requires 30 units of graduate level coursework. In addition to the required courses listed above, all students undertaking the Master's thesis track must complete the following to meet Graduate College unit requirements:

- CHEE 910—Thesis (5 units)
- CHEE 696A—Graduate Seminar (4 units)*
- Approved electives (9 units)

In this option, the student will develop a research project leading to the MS thesis. Upon the completion and successful approval of the MS thesis research by the thesis committee, the candidate is to submit to a Final Oral Defense Examination (see Section 4.2.5 herein). A copy of the signed cover page of the research document must be submitted to the GSC. The examination focuses on the research. The examining committee will consist of the MS Thesis Committee (see Section 4.2.5 herein). All members of the committee must be present during the examination while the presence of additional committee members is optional.

* Units listed allow students to meet Graduate College unit requirements, but the Department of Chemical and Environmental Engineering requires students to register for and regularly attend the Graduate Seminar each semester that they are in the CHEE program. Therefore, if a student takes more than 4 semesters to complete a degree, the student must register for CHEE 696A each semester after the 4 units are completed.

Non-thesis MS Students

The non-thesis MS track requires 30 units of graduate level coursework. In addition to the required courses listed above, all students undertaking the Master's non-thesis track must complete the following courses in order to meet Graduate College unit requirements:

- CHEE 909—Master's Report (3 units) *or*

- CHEE 594 *and* 1 unit of CHEE 909—One semester industrial internship w/ Report
- CHEE 696A—Graduate Seminar (2 units)*
- Approved electives (9 units)
- CHEE 900—(4 units)

In this option, the student will participate either in a one-semester research project or in a one-semester industrial internship. The non-thesis MS can be completed in one year by taking an additional elective in either fall or spring semesters, and completing CHEE 909 or CHEE 594 *and* 1 unit of CHEE 909 in the summer.

4.2.1 Sample Course Plan—Thesis ChE MS

The following table is to be used as a **general guide only**—please work with your Faculty Advisor and the Graduate Program Coordinator to determine your own individualized Plan of Study (see Section 4.2.4 following).

| | Fall | Spring |
|---------------|--|--|
| Year 1 | CHEE 502—Advanced Engineering Analysis (3) CHEE 505—Advanced Chemical Engineering Transport Phenomena (3) CHEE 506—Advanced Chemical Engineering Thermodynamics (3) CHEE 696A—Graduate Seminar (1) <i>Student must have a research advisor by the end of the first semester.</i> | CHEE 530—Chemical Reaction Engineering (3) Elective (3) CHEE 696A*—Graduate Seminar (1) CHEE 910—MS Thesis Research (1)** <i>Student must file Plan of Study no later than the end of the second semester.</i> |
| Year 2 | Elective (3) Elective (3) CHEE 696A*—Graduate Seminar (1) CHEE 910—MS Thesis Research (2)** | CHEE 696A*—Graduate Seminar (1) CHEE 910—MS Thesis Research (2)** <i>Student writes thesis proposal and orally defends it by end of the semester.</i> |

* Although 4 units of CHEE 696A Graduate Seminar are required to meet Graduate College requirements, students must take CHEE 696A Graduate Seminar each semester they are enrolled in the program. It is a department requirement. Therefore, if a student takes more than 4 semesters to complete a degree, the student must still register for CHEE 696A each semester after the 4 units are completed.

** Although only 5 units of CHEE 910 are required for the MS Thesis degree, more units are suggested if a student needs to maintain full-time status of 9 units per semester.

4.2.2 Sample Course Plan—Non-thesis ChE MS

The following table is to be used as a **general guide only**—please work with your Faculty Advisor and the Graduate Program Coordinator to determine your own individualized Plan of Study (see Section 4.2.4 following).

| | Fall | Spring |
|---------------|---|---|
| Year 1 | CHEE 502—Advanced Engineering Analysis (3) CHEE 505—Advanced Chemical Engineering Transport Phenomena (3) CHEE 506—Advanced Chemical Engineering Thermodynamics (3) CHEE 696A*—Graduate Seminar (1) <i>Student must have a research advisor by the end of the first semester.</i> | CHEE 530—Chemical Reaction Engineering (3) Elective (3) CHEE 900 (2) CHEE 696A*—Graduate Seminar (1) <i>Student must file Plan of Study no later than the end of the second semester.</i> |
| Year 2 | Elective (3) Elective (3) CHEE 900 (2) CHEE 696A*—Graduate Seminar (1) | CHEE 696A*—Graduate Seminar (1) CHEE 909—MS Research Report (3) <i>or</i> CHEE 594—Practicum (2) and 1 unit CHEE 909 ** |

* Although only 2 units of CHEE 696A Graduate Seminar are required to meet Graduate College requirements, students must take CHEE 696A Graduate Seminar each semester they are enrolled in the program. It is a department requirement.

** Although only 3 units of CHEE 909 are required for the MS Non-Thesis degree, more units are suggested if a student needs to maintain full-time status of 9 units per semester.

4.2.3 Sample Course Plan—Non-thesis ChE MS in 1 year

The following table is to be used as a **general guide only**—please work with your Faculty Advisor and the Graduate Program Coordinator to determine your own individualized Plan of Study (see Section 4.2.4 following).

| | Fall | Spring |
|---------------|--|---|
| Year 1 | CHEE 502—Advanced Engineering Analysis (3) CHEE 505—Advanced Chemical Engineering Transport Phenomena (3) CHEE 506—Advanced Chemical Engineering Thermodynamics (3) CHEE 900—Research (2) Elective (3) CHEE 696A—Graduate Seminar (1) <i>Student must have a research advisor by the end of the first semester.</i> <i>Student must file Plan of Study no later than the end of the first semester.</i> | CHEE 530—Chemical Reaction Engineering (3) Elective (3) Elective (3) CHEE 900—Research (2) CHEE 909—MS Report (3) CHEE 696A—Graduate Seminar (1) |

4.2.4 Plan of Study (MS Degree)

In conjunction with the student's faculty advisor, each MS student is responsible for developing a Plan of Study to be filed with the Graduate College using GradPath <https://grad.arizona.edu/gsas/gradpath> during their first or second semester of study, depending on their plan. The Plan of Study identifies (1) courses the student intends to transfer from other institutions; (2) courses already completed at The University of Arizona that the student intends to apply toward the graduate degree; and (3) additional course work to be completed in order to fulfill degree requirements. Students are encouraged to meet with the Graduate Program Coordinator to review the proposed Plan of Study before submitting it in order to correct inadvertent errors that will prevent its Graduate College approval. The Plan of Study must have the approval of the student's faculty advisor and chair of the GSC before it is submitted to the Graduate College. The student is responsible to be aware of the deadline to submit the GradPath Plan of Study for review.

4.2.5 Final Oral Presentation and Oral Defense Examination

MS Thesis: All MS Thesis students must report a thesis committee in GradPath, using the Master's/Specialist Committee Appointment Form. The committee will consist of the student's faculty advisor and two other members of the CHEE Faculty. Committee members from other institutions can be incorporated in addition to

the CHEE faculty as a courtesy and/or adjunct appointment as special members with the approval of the department and Graduate College. Upon completion and approval of the written MS research thesis by the Thesis Committee, the candidate must pass a Final Oral Defense Examination. The examining committee will consist of the MS Thesis Committee. All CHEE members of the committee must be present during the examination. The presence of additional committee members is optional. Note that, beginning in Spring 2020, all thesis approval pages must be completed through AdobeSign. Students must work with the Graduate Program Coordinator to get the approval page drafted and set up for signature.

MS Non-thesis: Non-thesis MS students do not need to have a thesis committee. In this option, the student will (1) participate in a one-semester research project and write a research report that will be approved by the student's faculty advisor overseeing the research, or (2) participate in a one-semester industrial internship and write a technical report about their experience. Prior to completion of the degree, however, the student will still need to go into GradPath and complete the Master's/Specialist Committee Appointment Form. The non-thesis student will open the form and click on the "No" button next to the question "Do you have a Master's Committee?" and then submit the form.

4.3 Accelerated MS Program (AMP Chemical Engineering)

4.3.1 Overview

The Accelerated Master's Program in Chemical Engineering (AMP ChE) is a program designed to enable advanced University of Arizona undergraduate students to complete both the Bachelor of Science degree and the Master of Science degree in ChE in a total of 5 years. This program is available only for undergraduate students in the Department of Chemical Engineering at the University of Arizona.

4.3.2 Eligibility Criteria

To be considered eligible to apply for the AMP ChE, the student must:

- Be a continuing University of Arizona undergraduate
- Have a minimum cumulative GPA of 3.30
- At the time of application, have completed a minimum of 75 units of undergraduate coursework; a minimum of 12 undergraduate units must have been completed in the student's major at the University of Arizona's main campus
- At the completion of the semester in which the student applies for the AMP, the student must have completed a minimum of 90 units of undergraduate coursework and maintained a minimum cumulative GPA of 3.30 for full admission to the program

Research experience as an undergraduate is not a requirement, but it is desirable.

4.3.3 How to Apply

Students who have completed a minimum of 75 units are eligible to apply, usually early in the second semester of the student's junior year (September or January). The student must create an account in GradApp (<https://apply.grad.arizona.edu>) and submit an online application to the Chemical Engineering AMP. (See <https://grad.arizona.edu/catalog/programinfo/CHEMSCHEAMP> for more details). Once students have completed 90 units (usually at the end of their junior year's second semester) and have a 3.30 or higher GPA, they will be conditionally admitted into the AMP. After conditional acceptance to the AMP program, students may register during their senior (fourth) year to take a combination of undergraduate and graduate courses but are still classified as undergraduate students. The graduate courses can double-count, serving both for the BS degree and as courses for the MS.

One exception is CHEE 420/520 (Chemical Reaction Engineering). CHEE 520 should not be taken to fulfill the required CHEE 420 undergraduate course. Graduate degrees are intended to take your education from basic undergraduate knowledge to a deeper or more specialized knowledge. If you are an engineer, you expect your graduate-level education not to be repetitive of content that you already know, but to have new content that will help you get a better understanding of processes and that will impart new knowledge on more specialized subjects. In view of this, core courses are not common to both undergraduate and graduate degrees with the exception of CHEE 420/520. Because CHEE 420 is a core (required) course for all Chemical Engineering undergraduate students, it may not be taken as a graduate course while in undergraduate status.

In order to be fully admitted into the MS Graduate Program, early in the second semester of their senior year (usually January), the AMP student must submit a new application for the MS in Chemical Engineering in order to be fully accepted into the CHEE MS program. The student will not be charged an application fee for this simplified application. An automatic application fee waiver will be granted. After completing the BS, students are then eligible to be fully accepted as MS degree students and matriculate into the graduate program.

In the fifth and final year, AMP students focus on graduate course work and their thesis or project.

4.3.4 Program requirements and guidelines

After admission into the AMP ChE program and during the student's final undergraduate year, the student must select a Faculty Advisor who will guide the student's research or development work toward the completion of a thesis or master's report. Writing either a thesis or a project report is required. CHEE 400 level courses that are convened with 500 level courses can be taken for both the BS and the AMP programs with the exception of CHEE 420/520 as explained in Section 4.3.3 above, but the 500 version of the course must be taken if it is to be used toward the AMP. Note that mostly graduate elective courses should be taken as an undergraduate. AMP students may take one core course as an undergrad in order to meet the requirements of their degree. The AMP ChE can be either thesis or non-thesis and will follow the same requirements of the traditional MS program with the following exceptions. Those who choose to follow the MS-Thesis track in their graduate year will take only 2 units of CHEE 696A instead of the usual 4. It is recommended that they take 2 units of CHEE 900 to complete the 30 units required by the Graduate College. Students who opt to follow the MS-non-thesis track in their graduate year will take only 1 unit of CHEE 900.

4.3.5 University of Arizona Graduate College policies on AMPs

Students will be considered undergraduates until they complete their undergraduate requirements, which should be no later than the end of their fourth year. Students must take at least 12 of their graduate credits while in graduate status.

Once admitted to the AMP, during the senior (or transition) year, students may take up to 12 units of graduate coursework, which may apply toward both the BS and the MS degrees. While an undergraduate, students are required to keep their graduate coursework cumulative GPA at 3.0 or higher to be fully admitted to the master's program upon completion of their BS degree.

During the senior (transition) year, students will be charged at the undergraduate rate and retain eligibility for undergraduate scholarships. After completion of all BS requirements, students will be granted graduate status, be charged at the graduate rate, and be eligible for graduate assistantships. Should a student have completed 12 graduate credits, but not yet completed the undergraduate degree, they will be considered a graduate for financial aid and tuition purposes. They will no longer be eligible for undergraduate scholarships, nor will they be eligible for graduate assistantships. Once all requirements for the undergraduate degree have been completed, at least 12 additional graduate units must be taken while in graduate status (with no pending undergraduate requirements to be completed). A total of 30 graduate credits (500 level courses or higher) must be taken.

AMP students should complete their undergraduate requirements no later than one semester before receiving their MS. Neither degree will be awarded until all undergraduate degree requirements have been completed.

4.3.6 Sample course plans for Thesis and Non-thesis AMP ChE (beginning with Senior year)

Sample Plan 1: BS in ChE and AMP in ChE (MS Thesis)

The following tables assume a student who is majoring in Chemical Engineering as an undergraduate, and they are to be used as a **general guide only**—please work with your Faculty Advisor, the Undergraduate Advisor (while in undergraduate status) and the Graduate Program Coordinator to determine your own individualized Plan of Study (see Section 4.3.7 herein).

| Semester 7 (Fall – Senior Year) | Semester 8 (Spring – Senior Year) |
|---|--|
| CHEE 401A—Chemical & Environmental Engineering Lab I (3) CHEE 442—Chemical Engineering Design Principles (3) CHEE 420—Chemical Reaction Engineering (3) CHEE 505—Advanced Chemical Engineering Transport Phenomena* (3) CHEE Graduate elective* (3) | CHEE 401B—Chemical & Environmental Engineering Lab II (1) CHEE 413—Intermed Engineering Analysis (3) CHEE 443—Chemical Engr Plant Design (3) CHEE Graduate elective* (3) CHEE Graduate elective* (3) <i>Student applies to graduate MS program by the end of the Spring semester.</i> |
| Semester 9 (Fall—Grad Year) | Semester 10 (Spring—Grad Year) |
| CHEE 502—Advanced Engineering Analysis (3) CHEE 506—Advanced Chemical Engineering Thermodynamics (3) CHEE 696A**—CHEE Graduate Seminar (1) CHEE 900—Research (2) <i>Student must have a research advisor by the end of the first semester in the grad program.</i> <i>Student must file Plan of Study no later than the end of the first semester in the grad program.</i> | CHEE 530—Advanced Chemical Reaction Engineering (3) CHEE 696A**—CHEE Graduate Seminar (1) CHEE 910—MS Thesis Research (5) <i>Student writes thesis proposal and orally defends it by the end of the semester.</i> |

* A student may take one core course as an undergraduate, but it is strongly recommended that students take their 3 elective courses (9 units) while in undergraduate status. CHEE 505 is used only as an example of a core course, but any of the other three core courses may be taken as an undergraduate. Up to two electives can be from Math or Science graduate programs. At least one elective must be from an Engineering graduate program; 400/500 level courses are acceptable for the AMP only if the 500 level version of the course is taken.

** Although 4 units of CHEE 696A Graduate Seminar is required to meet CHEE MS Thesis requirements, 2 units of the CHEE 696A Graduate Seminar requirement are waived for AMP MS-Thesis students. However, the student will need to take an additional 2 units in their program to meet the Graduate College 30 unit minimum for completion. It is recommended that MS Thesis students take 2 units of CHEE 900 (Research) in their graduate year.

Sample Plan 2: BS in ChE and AMP in ChE (non-thesis)

| Semester 7 (Fall—Senior Year) | Semester 8 (Spring—Senior Year) |
|--|---|
| CHEE 401A—Chemical & Environmental Engineering Lab I (3) CHEE 442—Chemical Engineering Design Principles (3) CHEE 420—Chemical Reaction Engineering (3) CHEE 505—Advanced Chemical Engineering Transport Phenomena* (3) CHEE Graduate elective* (3) | CHEE 401B—Chemical & Environmental Engineering Lab II (1) CHEE 413—Intermediate Engr Analysis (3) CHEE 443—Chemical Engr Plant Design (3) CHEE Graduate elective* (3) CHEE Graduate elective* (3) <i>Student applies to graduate MS program by the end of the Spring semester.</i> |
| Semester 9 (Fall—Grad Year) | Semester 10 (Spring—Grad Year) |
| CHEE 502—Advanced Engineering Analysis (3) CHEE 506—Advanced Chemical Engineering Thermodynamics (3) CHEE 696A**—Graduate Seminar (1) CHEE 900—Research (3) <i>Student must have a research advisor by the end of the first semester in the grad program.</i> <i>Student must file Plan of Study no later than the end of first semester in the grad program.</i> | CHEE 530—Advanced Chemical Reaction Engineering (3) CHEE 900—Research (1)*** CHEE 696A**—Graduate Seminar (1) CHEE 909—MS Research Report (3 units) <i>Student conducts a non-thesis research project</i> |

* A student may take one core course as an undergraduate, but it is strongly recommended that students take their 3 elective courses (9 units) while in undergraduate status. CHEE 505 is used only as an example of a core course, but any of the other three core courses may be taken as an undergraduate. Up to two electives can be from Math or Science graduate programs. At least one elective must be from an Engineering graduate program; 400/500 level courses are acceptable for the AMP only if the 500 level version of the course is taken.

** Although only 2 units of CHEE 696A Graduate Seminar are required to meet Graduate College requirements, students must take CHEE 696A Graduate Seminar each semester they are enrolled in the program. It is a department requirement.

*** Although only 4 units of CHEE 900 are required for the AMP MS Non-Thesis degree, more units are suggested if a student needs to maintain full-time status of 9 units per semester.

Sample Plan 3: BS in EnE and AMP in ChE (MS Thesis)

The following tables assume a student who is majoring in Environmental Engineering as an undergraduate, and they are to be used as a **general guide only**—please work with your Faculty Advisor, the Undergraduate Advisor (while in undergraduate status) and the Graduate Program Coordinator to determine your own individualized Plan of Study (see Section 4.3.7 herein).

| Semester 7 (Fall – Senior Year) | Semester 8 (Spring – Senior Year) |
|---|--|
| CHEE 400R—Water Chemistry for Engineers (3) CHEE 400A—Environmental Engineering Laboratory (1) CHEE 476A—Water Treatment Sys Design (3) CHEE 477R—Microbiology for Engineers (3) CHEE 505—Advanced Chemical Engineering Transport Phenomena* (3) CHEE Graduate elective* (3) | CHEE 474—Environmental Trans Processes (3) CHEE 476B—Wastewater Treatment System Design (3) CHEE Undergrad requirement or elective (3) CHEE Graduate elective* (3) CHEE Graduate elective* (3) <i>Student applies to graduate MS program by the end of the Spring semester.</i> |
| Semester 9 (Fall—Grad Year) | Semester 10 (Spring—Grad Year) |
| CHEE 502—Advanced Engineering Analysis (3) CHEE 506—Advanced Chemical Engineering Thermodynamics (3) CHEE 696A—CHEE Graduate Seminar (1)** CHEE 900—Research (2)** <i>Student must have a research advisor by the end of the first semester in the grad program.</i> <i>Student must file Plan of Study no later than the end of the first semester in the grad program.</i> | CHEE 530—Advanced Chemical Reaction Engineering (3) CHEE 696A—CHEE Graduate Seminar (1)** CHEE 910—MS Thesis Research (5) <i>Student writes thesis proposal and orally defends it by the end of the semester.</i> |

* A student may take one core course as an undergraduate, but it is strongly recommended that students take their 3 elective courses (9 units) while in undergraduate status. CHEE 505 is used only as an example of a core course, but any of the other three core courses may be taken as an undergraduate. Up to two electives can be from Math or Science graduate programs. At least one elective must be from an Engineering graduate program; 400/500 level courses are acceptable for the AMP only if the 500 level version of the course is taken.

** Although 4 units of CHEE 696A Graduate Seminar is required to meet CHEE MS Thesis requirements, 2 units of the CHEE 696A Graduate Seminar requirement are waived for AMP MS-Thesis students. However, the student will need to take an additional 2 units in their program to meet the Graduate College 30 unit minimum for completion. It is recommended that MS Thesis students take 2 units of CHEE 900 (Research) in their graduate year.

Sample Plan 4: BS in EnE and AMP in ChE (non-thesis)

| Semester 7 (Fall—Senior Year) | Semester 8 (Spring—Senior Year) |
|--|--|
| CHEE 400R—Water Chemistry for Engineers (3) CHEE 400A—Environmental Engineering Laboratory (1) CHEE 476A—Water Treatment Sys Design (3) CHEE 477R—Microbiology for Engineers (3) CHEE 505—Advanced Chemical Engineering Transport Phenomena* (3) CHEE Graduate elective* (3) | CHEE 474—Environmental Trans Processes (3) CHEE 476B—Wastewater Treatment System Design (3) CHEE Undergrad requirement or elective (3) CHEE Graduate elective* (3) CHEE Graduate elective* (3) <i>Student applies to graduate MS program by the end of the Spring semester.</i> |
| Semester 9 (Fall—Grad Year) | Semester 10 (Spring—Grad Year) |
| CHEE 502—Advanced Engineering Analysis (3) CHEE 506—Advanced Chemical Engineering Thermodynamics (3) CHEE 696A—Graduate Seminar (1)** CHEE 900—Research (3) <i>Student must have a research advisor by the end of the first semester in the grad program.</i> <i>Student must file Plan of Study no later than the end of first semester in the grad program.</i> | CHEE 530—Advanced Chemical Reaction Engineering (3) CHEE 900—Research (1)*** CHEE 696A**—Graduate Seminar (1) CHEE 909—MS Research Report (3) <i>Student conducts a non-thesis research project</i> |

* Student must take a 500-level course for it to count for both the graduate and undergraduate degrees. CHEE 505 is used only as an example of a core course, but any of the other three core courses may be taken as an undergraduate. Up to two electives can be from Math or Science graduate programs. At least one elective must be from an Engineering graduate program; 400/500 level courses are acceptable for the AMP only if the 500 level version of the course is taken.

** Although 2 units of CHEE 696A Graduate Seminar are required to meet Graduate College requirements, students must take CHEE 696A Graduate Seminar each semester they are enrolled in the program. It is a department requirement.

*** Although 4 units of CHEE 900 are required for the AMP MS Non-Thesis degree, more units are suggested if a student needs to maintain full-time status of 9 units per semester.

4.3.7 Plan of Study (ChE AMP Degree)

In conjunction with the student's faculty advisor, each AMP student is responsible for developing a Plan of Study to be filed with the Graduate College using GradPath <https://grad.arizona.edu/gsas/gradpath> during their first semester of study as a graduate student. The Plan of Study identifies (1) courses the student intends to transfer from other institutions; (2) courses already completed at The University of Arizona that the student intends to apply toward the graduate degree, including those completed as an undergraduate; and (3) additional course work to be completed in order to fulfill degree requirements. Students are encouraged to meet with the Graduate Program Coordinator to review the proposed Plan of Study before submitting it in order to correct

inadvertent errors that will prevent its Graduate College approval. The Plan of Study must have the approval of the student's advisor and chair of the Chemical Engineering GSC before it is submitted to the Graduate College. The student is responsible to be aware of the deadline to submit the GradPath Plan of Study for review.

4.3.8 Final Oral Presentation and Oral Defense Examination

MS Thesis: All MS Thesis students must report a thesis committee in GradPath, using the Master's/Specialist Committee Appointment Form. The committee will consist of the student's faculty advisor and two other members of the CHEE Faculty. Committee members from other institutions can be incorporated in addition to the CHEE faculty as a courtesy and/or adjunct appointment as special members with the approval of the department and Graduate College. Upon completion and approval of the written MS research thesis by the Thesis Committee, the candidate must pass a Final Oral Defense Examination. The examining committee will consist of the MS Thesis Committee. All CHEE members of the committee must be present during the examination. The presence of additional committee members is optional. Note that, beginning in Spring 2020, all thesis approval pages must be completed through AdobeSign. Students must work with the Graduate Program Coordinator to get the approval page drafted and set up for signature.

MS Non-thesis: Non-thesis MS students do not need to have a thesis committee. In this option, the student will (1) participate in a one-semester research project and write a research report that will be approved by the student's faculty advisor overseeing the research, or (2) participate in a one-semester industrial internship and write a technical report about their experience. Prior to completion of the degree, however, the student will still need to go into GradPath and complete the Master's/Specialist Committee Appointment Form. The non-thesis student will open the form and click on the "No" button next to the question "Do you have a Master's Committee?" and then submit the form.

4.4 Minor in Chemical Engineering

Nine units of courses are required. With the exception of students who are also majoring in Chemical Engineering, at least six units must come from the following core courses of the Chemical Engineering graduate program:

- CHEE 502—Advanced Engineering Analysis
- CHEE 505—Advanced Chemical Engineering Transport Phenomena
- CHEE 506—Advanced Chemical Engineering Thermodynamics
- CHEE 530—Advanced Chemical Reaction Engineering

The other three units must come from courses in the previous or the following list:

- CHEE 500R—Water Chemistry for Engineers*
- CHEE 512—Electrochemical Engineering
- CHEE 514—Sustainable Water Supplies for Remote Communities
- CHEE 520—Chemical Reaction Engineering
- CHEE 525—Emerging Issues in Water Quality
- CHEE 537—Surface Science
- CHEE 542—Bioremediation on Inorganic Contaminants
- CHEE 569A—Air Pollution I: Gases
- CHEE 569B—Air Pollution II: Aerosols
- CHEE 572—Interfacial Chemistry of Biomolecules in Environmental Systems
- CHEE 574—Fate and Transport Processes in Environmental Engineering*
- CHEE 576A—Water Treatment System Design*
- CHEE 576B—Wastewater Treatment System Design*
- CHEE 577R—Microbiology for Engineers*
- CHEE 578—Introduction to Hazardous Waste Management
- CHEE 581A—Engineering of Biological Processes
- CHEE 581B—Cell and Tissue Engineering
- CHEE 582—Analysis of Emerging Environmental Contaminants
- CHEE 583—Introduction to Polymeric Materials
- CHEE 587—Topics in Transport Phenomena
- CHEE 589—Trends in Nanomedicine Engineering: Fundamentals of Therapeutics and Drug Delivery Systems

* If the student minoring in Chemical Engineering is majoring in Environmental Engineering, this elective cannot be used for the minor because it is a required course for the major in Environmental Engineering.

Chemical Engineering PhD students who also minor in Chemical Engineering will take nine (9) units of elective Chemical Engineering courses that are not part of the Chemical Engineering core requirements to complete the minor.

A member from the Chemical Engineering graduate faculty will serve as the student's minor advisor and will serve as a member of the student's Doctoral Comprehensive Exam Committee.

5.0 Degree Requirements: Environmental Engineering

| | PhD* | Thesis MS | Non-Thesis MS |
|---|--------|-----------|---------------|
| Required Courses (CHEE 500R, 500A, 574, 576A&B, 577R, 676)** | 19 | 19 | 19 |
| Electives (excluding minor) | 12 | 6 | 6 |
| Minor*** | 9-12 | | |
| CHEE 696A (Graduate Seminar) | 5 **** | 1 **** | 1 **** |
| CHEE 910 (MS Thesis) | | 4 | |
| CHEE 909 (MS Non-thesis) | | | 4 |
| CHEE 920 (Dissertation) | 18 | | |
| <i>Total Units</i> | 63-66 | 30 | 30 |

* Students who enter the PhD program with an MS in Environmental Engineering or equivalent may transfer course work as part of the requirements for the PhD according to regulations stipulated by the Graduate College and approval by the Environmental Engineering GSC.

** Core courses are offered only once per academic year, either in the Fall or the Spring. Students must be aware of this when they are planning their studies.

*** Note that the Graduate College requires 36 units of major coursework exclusive of the minor for the PhD. Therefore, if the PhD minor requires more than 9 units of minor coursework (e.g. 12 units), the student will need to take additional units of coursework in the major. Students should work with the Graduate Program Coordinator to make sure that they take the required number of major units. The Graduate College also requires that at least 22 units of the required major and minor units must be graded units (i.e., A/B).

**** Note that all CHEE graduate students must register and regularly attend CHEE 696A (Graduate Seminar) each semester that they are in their respective programs. However, their Plan of Study should include only the numbers listed in the table above to meet Graduate College requirements and allow the PhD students to advance to candidacy after completion of the Comprehensive Exam.

The Graduate College website summarizes this information at: <https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy>. For more information about the Accelerated Master Program (AMP) leading to the Thesis or Non-Thesis MS degree, you may refer to Section 5.3 of this handbook.

Descriptions for the courses shown in subsequent pages can be found at this website: <https://chee.engineering.arizona.edu/grad-programs/courses>.

5.1 PhD Program (Environmental Engineering)

The department requires thirty-seven units of coursework for the major and minor subjects and an additional eight units of seminar (CHEE 696A), exclusive of dissertation research. Note that students wishing to advance to candidacy immediately after successfully completing their Oral Comprehensive Exam (see Section 5.1.6 herein) should list no more than 5 or 6 units of CHEE 696A on their Plan of Study (see Section 5.1.5). Eighteen units of dissertation research (CHEE 920) are the additional requirement for the PhD degree.

5.1.1 Course Requirements Environmental Engineering (EnE) PhD

All Environmental Engineering PhD students are required to take the following core courses at the UA or an approved equivalent elsewhere:

- CHEE 500R—Water Chemistry for Engineers (3 units)
- CHEE 500A—Environmental Engineering Laboratory (1 unit)
- CHEE 574—Environmental Transport Processes (3 units)
- CHEE 576A—Water Treatment System Design (3 units)
- CHEE 576B—Wastewater Treatment System Design (3 units)
- CHEE 577R—Microbiology for Engineers (3 units)
- CHEE 676—Advanced Water and Wastewater Treatment (3 units)

To meet Graduate College unit requirements, Environmental Engineering PhD students will take a minimum of 12 units of electives, 9-12 units of minor courses (depending on requirements of the minor department), and 5 or more units of CHEE 696A (Graduate Seminar)*. No more than nine (9) units of elective courses can be in non-graded courses. The degree also requires 18 units of Dissertation Research. According to the Graduate College, at least 22 units of the combined major and minor course work must be in courses in which regular grades (A/B) have been earned. Students who enter the PhD program with an MS in environmental engineering may transfer up to 30 units of coursework after approval from the Graduate College and the Environmental Engineering Graduate Studies Committee (GSC), and will be evaluated individually to devise a Plan of Study (see Section 5.1.5).

Note also that minor unit requirements can vary by department. According to the Graduate College, if the student minors in a subject that requires more than 9 units of coursework, the student will still need to take a full 36 units of major coursework, exclusive of dissertation units, that must be reflected on the submitted Plan of Study (see Section 5.1.5). This may affect the number of elective units that the student must take under major coursework.

- * Units listed are to allow students to meet Graduate College unit requirements and advance to candidacy after completion of their Comprehensive Exam, but the Department of Chemical and Environmental Engineering requires students to register for and regularly attend the Graduate Seminar each semester that they are in the CHEE program.

5.1.2 Sample Course Plan—Environmental Engineering PhD

The following table is to be used as a **general guide only**—please work with your Faculty Advisor and the Graduate Program Coordinator to determine your own individualized Plan of Study (see Section 5.1.5). Specific course requirements are discussed in Section 5.1.1 above.

| | Fall | Spring |
|---------------|--|--|
| Year 1 | CHEE 500R—Water Chemistry for Engineers (3) CHEE 500A—Environmental Engineering Laboratory (1) CHEE 576A—Water Treatment System Design (3) CHEE 577R—Microbiology for Engrs (3) CHEE 696A—Graduate Seminar* (1) CHEE 920—Dissertation Research (1) <i>Student should have a research advisor by end of this semester.</i> | CHEE 574—Environmental Transport Processes (3) Elective (or minor) (3) Elective (or minor) (3) CHEE 696A—Graduate Seminar* (1) CHEE 920—Dissertation Research (1) <i>Any student with a GPA <3.75 in the core courses 500R, 500A, 574, 576A & B, and 577R must take the written qualification exam the next time it is offered. The exam is waived for GPA ≥ 3.75.</i> |
| Year 2 | CHEE 576B—Wastewater Treatment System Design (3) Elective (or minor) (3) CHEE 696A—Graduate Seminar* (1) CHEE 920—Dissertation Research (2) <i>The student's Plan of Study is due by the end of the third semester.</i> <i>Student works with their Faculty Advisor to determine their Graduate Committee by the end of their 3rd semester in the program.</i> | CHEE 676—Advanced Water and Wastewater Treatment (3) Elective (or minor) (3) Elective (or minor) (3) CHEE 696A—Graduate Seminar* (1) CHEE 920—Dissertation Research (1) <i>Determine Comp Exam date and file Announcement of Doctoral Comp Exam Form in GradPath before end of semester.</i> <i>All students must take the Comprehensive exam: (i) write their thesis proposal; and (ii) orally defend their thesis proposal by the beginning of the next fall semester.</i> |
| Year 3 | Elective (or minor) (3) Elective (or minor) (3) CHEE 696A*—Graduate Seminar (1) CHEE 920—Dissertation Research (2) ** <i>Students who have passed the Comprehensive exam should plan to TA at least one semester.</i> | CHEE 696A*—Graduate Seminar (1) CHEE 920—Dissertation Research (8) ** |
| Year 4 | CHEE 696A*—Graduate Seminar (1) CHEE 920—Dissertation Research (8) ** | CHEE 696A*—Graduate Seminar (1) CHEE 920—Dissertation Research (8) ** |

* Candidates wishing to advance to candidacy immediately following their Comprehensive Exam cannot have any outstanding non CHEE 920 units listed on their Plan of Study or they will not advance until they complete those units. Therefore, while required by the department, these courses cannot be listed on the Plan of Study if they are to be taken after the Comprehensive Exam.

** Although 18 units of CHEE 920 are required for the PhD degree, more units are suggested if a student needs to maintain full-time status of 9 units per semester.

5.1.3 Qualifying Examination

The PhD Qualifying Examination is a written exam offered once per year. The subjects evaluated are Environmental Transport, Water Chemistry, Environmental Microbiology, and Water Treatment and Wastewater Treatment System Design. The written qualifying exam is waived for students with a GPA of 3.75 or greater in the core courses CHEE 500R, 500A, 574, 576A, 576B, and 577R. Students taking the Qualifying Exam will take the sections of the exam that apply to subjects for which they did not receive a grade of “A.” Students must take the exam the first time it is offered after they have completed the core courses. A student failing the Qualifying Examination can retake it once, provided that their advisor agrees. If consent is obtained, students failing section(s) of the exam will retake the exam for that (those) section(s). The retake will be offered three months after the student is informed of the grade obtained in the initial exam. If the student fails any part of the exam again, then the student will have failed the written qualification exam and will be placed on the MS track. The Qualifying Examination should be taken no later than the start of the third academic year.

For international transfer students and those students entering with a degree other than environmental engineering, the GSC will work with the student to develop a Plan of Study (see Section 5.1.5) that will prepare them for the Qualifying Exam. Transfer students from United States universities and those entering with an MS in Environmental Engineering will be evaluated individually to devise plans for courses and the Qualifying Exam.

5.1.4 Choice of Minor

All PhD students must fulfill the requirements for a minor in a program of their choice. Selection of the minor should be compatible with the student’s research interests and discussed with their research advisor. Minors are administered and approved by the minor department. They typically consist of 9 to 12 units of course work. Note that in the event that the student selects a minor that requires more than 9 units of minor coursework (e.g. 12 units), the student may need to take additional units of major coursework in order to meet the 36 units, exclusive of dissertation units, required by the Graduate College. The student should work with the Graduate

Program Coordinator to make sure the correct number of units are included in the Plan of Study (see Section 5.1.5 following) to meet the Graduate College requirement.

5.1.5 Plan of Study

In conjunction with their faculty advisor, each student is responsible for developing and filing a Plan of Study as described in the Graduate College requirements. The Plan of Study identifies (1) courses the student intends to transfer from other institutions; (2) courses already completed at The University of Arizona that the student intends to apply toward the graduate degree; and (3) additional course work to be completed in order to fulfill degree requirements.

Note, however, that students should not list more than 6 units of CHEE 696A on their Plans of Study even though the department requires that they register and attend the seminar each semester (see Section 3.6 herein). The Graduate College requires that only dissertation units be left to complete on the Plan of Study in order for the student to be able to advance to candidacy following successful completion of the oral and written Comprehensive Exam (see Section 5.1.6 below). Therefore, the student must register and attend the Graduate Seminar each semester following the Comprehensive Exam, but the student cannot have any outstanding non-dissertation requirements listed on the Plan of Study.

Students are encouraged to meet with the Graduate Program Coordinator to review the proposed Plan of Study before submitting it in GradPath in order to correct inadvertent errors that will prevent its Graduate College approval or prevent the student from advancing to candidacy after they successfully complete their Comprehensive Exam. The Plan of Study must have the approval of the student's faculty advisor, minor advisor, and the Chair of the Environmental Engineering GSC before it is submitted to the Graduate College. The Graduate College states that PhD students must submit their Plan of Study no later than the third semester in residence at The University of Arizona.

5.1.6 Comprehensive Examination

Before admission to candidacy for the doctoral degree, the student must pass both a written and an oral Doctoral Comprehensive Examination. These examinations are intended to test the student's comprehensive knowledge of the major and minor subjects of study, both in breadth across the general field of study, and in depth within the area of specialization. The Comprehensive Examination is considered a single examination, although it consists of written and oral parts. The minor department controls the minor portion of the written examination and may waive it at their discretion. The examining committee must consist of a minimum of four members,

three of whom are selected from the Chemical & Environmental Engineering faculty and one of whom represents the candidate's minor. All committee members must be University of Arizona tenured, tenure-track, or approved as equivalent. Before scheduling the exam all students must file the Comprehensive Exam Committee Appointment Form in GradPath.

Written Comprehensive Examination. The written part of the Comprehensive Examination consists of a written research proposal. This document should contain a thorough literature analysis of the subject of the dissertation research (i.e., the state of the art), and a detailed research plan on which subsequent dissertation-related work will be premised. The entire document, not including appendices and references, must be a minimum of 10 and not more than 20 pages (single-spaced in a traditional research article format and font). The written document, after approval by the student's faculty advisor, must be submitted to the other members of the examining committee not less than two weeks prior to the oral comprehensive exam and must be approved by all committee members prior to the oral comprehensive exam.

The written Comprehensive exam must be completed and approved successfully prior to undertaking the oral part of the Comprehensive exam.

Oral Comprehensive Examination. The Oral Comprehensive Examination is conducted by the student's Comprehensive Examination Committee. The student must display a broad knowledge of the chosen field of study and sufficient depth of understanding on the major and minor fields to pass this exam. Discussion of proposed dissertation research may be included. The examining committee must attest that the student has demonstrated the professional level of knowledge expected of a junior academic colleague. The Graduate College allows no more than one re-take of the oral exam.

When the student has passed the written and oral portions of the Comprehensive Examination, and the Graduate Student Academic Services Office (within the Graduate College) has confirmed completion of the required courses on the approved doctoral Plan of Study, the student will advance to doctoral candidacy.

5.1.7 Timeline for Comprehensive Examination and Requirements

According to the Graduate College, the written and oral portions of the comprehensive examination should take place at least six months prior to the Final Oral Examination (defense of dissertation), and they must be completed no less than 3 months ahead of the oral defense of the dissertation. The Oral Comprehensive Examination is performed upon successful completion of the written examinations in the major and minor(s).

The exact time and place of the oral comprehensive examination must be scheduled with the department and approved in GradPath using the Announcement of Doctoral Comprehensive Exam form before the exam can take place.

To satisfy the requirements of the Comprehensive Examination a student must:

- File a Plan of Study with the Graduate College through GradPath (as approved by the Graduate Studies Committee)
- Satisfy all requirements stipulated by the minor department or program
- Complete all required courses, and a minimum of 90% of *all* coursework
- Complete the Written Comprehensive Examination as described above
- Take and successfully pass the Oral Comprehensive Examination as described above

5.1.8 Dissertation Committee

When the student has an approved doctoral Plan of Study on file and approved in GradPath, has satisfied all course work, and passed the written and oral portions of the Comprehensive Examination, the student must file the Doctoral Dissertation Committee Appointment form in GradPath. The Doctoral Dissertation Committee must include a minimum of three members, all of whom must be University of Arizona tenured, tenure-track, or approved as tenure-equivalent for the purposes of serving on graduate committees. It must include the student's faculty advisor and two other members of the Chemical & Environmental Engineering Department faculty. Additional committee members may include eligible members of the CHEE department or the candidate's minor department, other UA department faculty, or a specially approved member from outside the UA faculty. Students must submit the names of their doctoral committee to GradPath.

Any changes to the committee should be reported to the Graduate Student Academic Services office. Under normal circumstances, submission is expected at least six months before the Final Oral Examination (i.e., Defense). The Committee Appointment form reports the student's planned dissertation committee, dissertation title (subject to change) and the expected graduation term. It requires approval from the student's dissertation director (faculty advisor) and the major and minor departments. The approval signature from the minor department on this form indicates both approval of the reported dissertation committee and confirmation that the student has satisfied all requirements for the minor.

5.1.9 Final Oral Defense Examination

Upon the completion and successful approval of the dissertation research by the dissertation committee, the candidate must successfully complete a Final Oral Defense Examination. A copy of the signed cover page of

the dissertation document must be submitted to the GSC. 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 examining committee will be the Dissertation Committee described in Section 5.1.8 herein. Committee members representing the minor program must be invited to the defense, but their participation is optional. The candidate must submit an announcement of their final Oral Defense via GradPath at least two weeks before their defense. Additional information on the dissertation defense may be found at <https://grad.arizona.edu/gsas/degree-requirements/doctor-philosophy#final-oral-defense>. If the defense will be conducted by Zoom or other online platform, the candidate must also provide the link to the online defense to the Graduate Program Coordinator (Gracefuller@arizona.edu) so that the public portion of the defense can be announced to the Department of Chemical and Environmental Engineering. Note that, beginning in Spring 2020, all dissertation approval pages must be completed through AdobeSign. Students must work with the Graduate Program Coordinator to get the approval page drafted and set up for signature.

5.1.10 Publications

Having multiple publications successfully submitted while still in graduate school greatly enhances the student's potential for landing either a faculty position at an accredited university or a research position at a major corporation. Therefore, prior to graduating, PhD students are strongly encouraged to have two publications either accepted, in press or published in peer-reviewed, indexed journals. These publications should form a major part of the student's dissertation. Copies of any publications must be submitted to the Graduate Program Coordinator for delivery to the chair of the Graduate Studies Committee and the department chair, along with the Publications Form (see Appendix A8, but also available in the department's office), before the final oral examination is scheduled. A successful submission of a manuscript to a peer-reviewed journal can be counted as a publication on the publications form. When a publication has been accepted by a peer-reviewed, indexed journal, email the citation to the Graduate Program Coordinator for department records.

5.2 MS Program (*Environmental Engineering*)

All Environmental Engineering MS students are required to take the following courses at the University of Arizona or an approved equivalent elsewhere:

- CHEE 500R—Water Chemistry for Engineers (3 units)
- CHEE 500A—Environmental Engineering Laboratory (1 unit)
- CHEE 574—Environmental Transport Processes (3 units)
- CHEE 576A—Water Treatment System Design (3 units)
- CHEE 576B—Wastewater Treatment System Design (3 units)
- CHEE 577R—Microbiology for Engineers (3 units)
- CHEE 676—Advanced Water and Wastewater Treatment (3 units)

Thesis MS students

The thesis MS track requires 30 units of graduate level coursework. In addition to the required courses listed above, all students undertaking the Master's thesis track must complete the following:

- CHEE 910—Thesis (4 units)
- CHEE 696A—Graduate Seminar (1 unit)
- Approved electives (6 units)

In this option, the student will develop a research project leading to the MS thesis. Upon the completion and successful approval of the MS thesis research by the thesis committee, the candidate is to submit to a Final Oral Defense Examination. A copy of the signed cover page of the research document must be submitted to the GSC. The examination focuses on the research. The examining committee will consist of the MS Thesis Committee (see Section 5.2.3 herein). All members of the committee must be present during the examination while the presence of additional committee members is optional.

Non-thesis MS students

The non-thesis MS track requires 30 units of coursework. In addition to the required courses listed above, all students undertaking the Master's non-thesis track must complete the following courses:

- CHEE 909—Master's Report (4 units)
- CHEE 696A—Graduate Seminar (1 unit)
- Approved electives (6 units)

In this option, the student will develop a non-thesis research project leading to an MS written report. Upon the completion and successful approval of the student's research project by an appointed non-thesis committee, the candidate will present the report before the non-thesis committee (see Section 5.2.3 herein).

5.2.1 Sample Course Plan for Thesis or Non-thesis EnE MS

The following table is to be used as a **general guide only**—please work with your Faculty Advisor and the Graduate Program Coordinator to determine your own individualized Plan of Study (see Section 5.2.2).

| | Fall | Spring |
|---------------|--|---|
| Year 1 | CHEE 500R—Water Chem for Engineers (3) CHEE 500A—Environmental Engineering Laboratory (1) CHEE 576A—Water Treatment System Design (3) CHEE 577R—Microbiology for Engrs (3) CHEE 696A—Graduate Seminar (1) * <i>Student must have a research advisor by the end of the first semester.</i> | CHEE 574—Environmental Transport Processes (3) Elective (3) Elective (3) CHEE 696A*—Graduate Seminar (1) <i>Student must file Plan of Study no later than the end of the second semester.</i> |
| Year 2 | CHEE 576B—Wastewater Treatment System Design (3) CHEE 696A—Graduate Seminar (1) CHEE 910—MS Thesis Research <i>or</i> CHEE 909—MS Research Report (2) ** | CHEE 676—Advanced Water and Wastewater Treatment (3) CHEE 696A—Graduate Seminar (1) CHEE 910—MS Thesis Research (2) ** <i>Student writes thesis proposal and orally defends it by end of the semester. or</i> CHEE 909—MS Research Report (2) ** <i>Student conducts a non-thesis research project and presents it in front of a non-thesis committee.</i> |

* Although only 1 unit of CHEE 696A Graduate Seminar is required to meet Graduate College requirements, students must take CHEE 696A Graduate Seminar each semester they are enrolled in the program. It is a department requirement.

** Although only 4 units of CHEE 910 or CHEE 909 are required for the MS Thesis degree, more units are suggested if a student needs to maintain full-time status of 9 units per semester.

5.2.2 Plan of Study (MS Degree)

In conjunction with the student's faculty advisor, each MS student is responsible for developing a Plan of Study to be filed with the Graduate College using GradPath <https://grad.arizona.edu/gsas/gradpath> during their second semester of study. The Plan of Study identifies (1) courses the student intends to transfer from other institutions; (2) courses already completed at The University of Arizona that the student intends to apply toward the graduate degree; and (3) additional course work to be completed in order to fulfill degree requirements. Students are encouraged to meet with the Graduate Program Coordinator to review the proposed Plan of Study before submitting it in order to correct inadvertent errors that will prevent its Graduate College approval. The

Plan of Study must have the approval of the student's advisor and chair of the GSC before it is submitted to the Graduate College. The student is responsible to be aware of the deadline to submit the GradPath Plan of Study for review.

5.2.3 Selection of Thesis or Non-Thesis Committee and Final Oral Presentation

After completion of the Plan of Study, it is the responsibility of the student and their faculty advisor to select a Thesis or Non-thesis Committee (depending on whether the student is pursuing a thesis or non-thesis degree). The committee will consist of the student's faculty advisor and two other members of the CHEE Faculty. Committee members from other institutions can be incorporated in addition to the CHEE Faculty as a courtesy and/or adjunct appointment as special members with the approval of the department and Graduate College.

MS Thesis: All MS Thesis students must report a thesis committee in GradPath, using the Master's/Specialist Committee Appointment Form. Upon completion and approval of the written MS research thesis by the Thesis Committee, the candidate must pass a Final Oral Defense Examination. The examining committee will consist of the MS Thesis Committee. All CHEE members of the committee must be present during the examination. The presence of additional committee members is optional. Note that, beginning in Spring 2020, all thesis approval pages must be completed through AdobeSign. Students must work with the Graduate Program Coordinator to get the approval page drafted and set up for signature.

MS Non-thesis: Upon the completion and approval of the written MS research report by the MS Non-thesis Committee, the candidate must give a Final Oral Presentation and answer questions from the Committee and the audience. The examining committee will consist of the MS Non-thesis Committee. All CHEE members of the committee should be present during the presentation. The presence of additional committee members is optional.

All MS students, whether thesis or non-thesis, must complete a Master's Committee Appointment Form in GradPath. MS Thesis students will check the "Yes" button next to the question "Do you have a Master's committee?" Thesis students must list their thesis committee members before they submit the form. Non-thesis students will check the "No" button next to the question "Do you have a Master's committee?" and then submit the form.

5.3 Accelerated MS Program (AMP Environmental Engineering)

5.3.1 Overview

The Accelerated Master's Program in Environmental Engineering (AMP EnE) is a program designed to enable advanced University of Arizona undergraduate students to complete both the Bachelor of Science degree and the Master of Science degree in Environmental Engineering in a total of 5 years. This program is available only for undergraduate students in 1) Environmental Engineering, 2) Chemical Engineering, 3) Civil Engineering, and 4) Environmental Science at the University of Arizona.

5.3.2 How to apply

Students who have completed a minimum of 75 units are eligible to apply, usually early in the second semester of the student's junior year (September or January). The student must create an account in GradApp (<https://apply.grad.arizona.edu>) and submit an online application to the Environmental Engineering AMP. (See <https://grad.arizona.edu/catalog/programinfo/CHEMSCHEAMP>) for more details. Once students have completed 90 units (usually at the end of their junior year's second semester) and have a 3.30 or higher GPA, they may be accepted into the AMP. After acceptance to the AMP program, students register during their senior (fourth) year to take a combination of undergraduate and graduate courses and are classified as undergraduate students. The graduate (500-level) courses can double-count, serving both as core or elective courses for the BS degree and as core or elective courses for the MS. In order to be fully admitted into the MS Graduate Program, early in the second semester of their senior year (usually January), the AMP student must submit a new application for the MS in Chemical Engineering in order to be fully accepted into the CHEE MS program. The student will not be charged an application fee for this simplified application. An automatic application fee waiver will be granted.

After completing the BS, students are then eligible to be fully accepted as MS degree students and matriculate into the graduate program. In the fifth and final year, students focus on graduate course work and their thesis or project.

5.3.3 Eligibility criteria

To be considered eligible to apply for the AMP EnE, students must:

- Be a continuing University of Arizona undergraduate
- Have a minimum cumulative GPA of 3.30

- At the time of application, have completed a minimum of 75 units of undergraduate course work; a minimum of 12 undergraduate units must have been completed in the student's major at the University of Arizona's main campus
- At the completion of the semester in which the student applies for the AMP, the student must have completed a minimum of 90 units of undergraduate coursework and maintained a minimum cumulative GPA of 3.30 for full admission to the program

Research experience as an undergraduate is not a requirement, but it is desirable.

5.3.4 University of Arizona Graduate College policies on AMPs

Students will be considered undergraduates until they complete their undergraduate requirements, which should be no later than the end of their fourth year. Students must take at least 12 of their graduate credits while in graduate status. In other words, during years 1–3 (or approximately 0–90 credits) students will be taking undergraduate coursework and charged at the undergraduate rate.

Once admitted to AMP, during the senior (or transition) year, students may take up to 12 units of graduate coursework, which may apply toward both the BS and the MS degrees. Students will be charged at the undergraduate rate and retain eligibility for undergraduate scholarships. After completion of all BS requirements, students will be granted graduate status, be charged at the graduate rate, and be eligible for graduate assistantships. Should a student have completed 12 graduate credits, but not yet completed the undergraduate degree, they will be considered graduate for financial aid and tuition purposes. They will no longer be eligible for undergraduate scholarships. Nor will they be eligible for graduate assistantships. Once all requirements for the undergraduate degree have been completed, at least 12 additional graduate units must be taken while in graduate status (with no pending undergraduate requirements to be completed). A total of 30 graduate credits (500 level courses or higher) should be taken.

AMP students should complete their undergraduate requirements no later than one semester before receiving their MS. Students who finish their undergraduate requirements later than one semester before earning their master's will no longer be eligible for undergraduate scholarships or for graduate assistantships. Neither degree will be awarded until all undergraduate degree requirements have been completed.

5.3.5 Program requirements and guidelines

After admission into the AMP EnE program, students must select a faculty advisor who will guide the student's research or development work toward the completion of a thesis or master's report. Writing a thesis or a project report is required.

CHEE 400-level courses that are convened with 500-level courses can be taken as core and/or electives for both the BS and the AMP programs—the 500-level version of the course must be taken in this case.

5.3.6 Sample course plans for Thesis and Non-thesis AMP EnE (beginning with Senior year)

Sample plans for AMP students majoring in both Environmental Engineering and other majors as undergraduate students (thesis or non-thesis) follow, beginning with the 7th semester (senior year) of undergraduate work:

Sample Plan 1: BS in EnE and AMP in EnE

The following table assumes a student who is majoring in Environmental Engineering as an undergraduate, and it is to be used as a **general guide only**—please work with your Faculty Advisor, the Undergraduate Advisor (while in undergraduate status) and the Graduate Program Coordinator to determine your own individualized Plan of Study (see Section 5.3.7 herein).

| Semester 7 (Fall – Senior Year) | Semester 8 (Spring – Senior Year) |
|--|---|
| CHEE 400/550R—Water Chemistry for Engineers* (3) CHEE 400/500A—Environmental Engineering Laboratory* (1) CHEE 477R/577R—Microbiology for Engrs* (3) CHEE 476/576A—Water Treatment System Design* (3) | CHEE Undergrad requirement or elective (3) CHEE Undergrad requirement or elective (3) CHEE 474/574—Environmental Transport Processes* (3) CHEE 476B/576B—Wastewater Treatment System Design* (3) <i>Student applies to graduate MS program by the end of the Spring semester.</i> |
| Semester 9 (Fall—Grad Year) | Semester 10 (Spring—Grad Year) |
| CHEE 476B/576B—Wastewater Treatment System Design* (3) CHEE Graduate elective (3) CHEE 696A—Graduate Seminar (1) CHEE 910—MS Thesis Research (2) <i>or</i> CHEE 909—MS Research Report (2) <i>Student must have a research advisor by the end of the first semester in the grad program.</i> <i>Student must file Plan of Study no later than the end of the first semester of graduate work.</i> | CHEE 676—Advanced Water and Wastewater Treatment (3) CHEE Graduate elective (3) CHEE 696A**—Graduate Seminar (1) CHEE 910—MS Thesis Research (2) <i>Student writes thesis proposal and orally defends it by the end of the semester, or</i> CHEE 909—MS Research Report (2) <i>Student conducts a non-thesis research project and presents it in front of a non-thesis committee.</i> |

* Student must take a 500-level graduate course in order for it to count for both undergraduate and graduate credit. (See Section 5.3.5 herein) Note that because CHEE 400R/500R, 400A/500A, 474/574, 476/576A&B, and 477R/577R, are all required for the undergraduate Environmental Engineering degree, these are the recommended courses from which students should determine the 12 units of graduate courses that will apply toward their graduate degree. However, **only** 12 units will apply toward the graduate degree. Environmental Engineering undergraduates will therefore need to take an additional elective as graduate students in order to meet Graduate College requirements.

** Although only 1 unit of CHEE 696A Graduate Seminar is required to meet Graduate College requirements, students must take CHEE 696A Graduate Seminar each semester they are enrolled in the program. It is a department requirement.

Sample Plan 2: BS in other undergraduate major and AMP in EnE

The following table assumes a student who is majoring in an area other than Environmental Engineering (e.g., Civil Engineering or Soil, Water & Environmental Science) as an undergraduate, and it is to be used as a **general guide only**—please work in tandem with your department’s Undergraduate Advisor, the CHEE Undergraduate Advisor (while in undergraduate status) and the CHEE Graduate Program Coordinator to determine your own individualized Plan of Study (see Section 5.3.7 herein).

| Semester 7 (Fall – Senior Year) | Semester 8 (Spring – Senior Year) |
|--|--|
| Undergraduate requirement or elective (3) Undergraduate requirement or elective (3) CHEE 576A—Water Treatment Sys Design (3) CHEE 577R—Microbiology for Engineers* (3) | Undergraduate requirement or elective (3) Undergraduate requirement or elective (3) CHEE Graduate elective* (3) CHEE Graduate elective* (3) <i>Student applies to graduate MS program by the end of the Spring semester.</i> |
| Semester 9 (Fall—Grad Year) | Semester 10 (Spring—Grad Year) |
| CHEE 500R—Water Chem for Engineers (3) CHEE 500A—Environmental Engineering Laboratory (1) CHEE 576B—Wastewater Treatment System Design (3) CHEE 696A—Graduate Seminar (1) CHEE 910—MS Thesis Research (2) <i>or</i> CHEE 909—MS Research Report (2) <i>Student must have a research advisor by the end of the first semester in the grad program.</i> <i>Student must file Plan of Study no later than the end of the first semester of graduate work.</i> | CHEE 676—Advanced Water and Wastewater Treatment (3) Graduate elective (3) CHEE 696A**—Graduate Seminar (1) CHEE 910—MS Thesis Research (2) <i>Student writes thesis proposal and orally defends it by end of the semester. or</i> CHEE 909—MS Research Report (2) <i>Student conducts a non-thesis research project and presents it in front of a non-thesis committee.</i> |

* Student must take a 500-level elective graduate course in order for it to count for both undergraduate and graduate credit. (See Section 5.3.5 herein)

** Although only 1 unit of CHEE 696A Graduate Seminar is required to meet Graduate College requirements, students must take CHEE 696A Graduate Seminar each semester they are enrolled in the program. It is a department requirement.

5.3.7 Plan of Study (EnE AMP Degree)

In conjunction with the student’s faculty advisor, each AMP student is responsible for developing a Plan of Study to be filed with the Graduate College using GradPath <https://grad.arizona.edu/gsas/gradpath> during their first semester of study as a graduate student. The Plan of Study identifies (1) courses the student intends to transfer from other institutions; (2) courses already completed at The University of Arizona that the student

intends to apply toward the graduate degree, including those completed as an undergraduate; and (3) additional course work to be completed in order to fulfill degree requirements. Students are encouraged to meet with the Graduate Program Coordinator to review the proposed Plan of Study before submitting it in order to correct inadvertent errors that will prevent its Graduate College approval. The Plan of Study must have the approval of the student's advisor and chair of the Environmental Engineering GSC before it is submitted to the Graduate College. The student is responsible to be aware of the deadline to submit the GradPath Plan of Study for review.

5.3.8 Selection of Thesis or Non-Thesis Committee and Final Oral Presentation

After completion of the Plan of Study, it is the responsibility of the student and their faculty advisor to select a Thesis or Non-thesis Committee (depending on whether the student is pursuing a thesis or non-thesis degree). The committee will consist of the student's faculty advisor and two other members of the CHEE Faculty. Committee members from other institutions can be incorporated in addition to the CHEE Faculty as a courtesy and/or adjunct appointment as special members with the approval of the department and Graduate College.

MS Thesis: All MS Thesis students must report a thesis committee in GradPath, using the Master's/Specialist Committee Appointment Form. Upon completion and approval of the written MS research thesis by the Thesis Committee, the candidate must pass a Final Oral Defense Examination. The examining committee will consist of the MS Thesis Committee. All CHEE members of the committee must be present during the examination. The presence of additional committee members is optional. Note that, beginning in Spring 2020, all thesis approval pages must be completed through AdobeSign. Students must work with the Graduate Program Coordinator to get the approval page drafted and set up for signature.

MS Non-thesis: Upon the completion and approval of the written MS research report by the MS Non-thesis Committee, the candidate must give a Final Oral Presentation and answer questions from the Committee and the audience. The examining committee will consist of the MS non-thesis Committee. All CHEE members of the committee should be present during the presentation. The presence of additional committee members is optional.

All MS students, whether thesis or non-thesis, must complete a Master's Committee Appointment Form in GradPath. MS Thesis students will check the "Yes" button next to the question "Do you have a Master's committee?" Thesis students must list their thesis committee members before they submit the form. Non-thesis students will check the "No" button next to the question "Do you have a Master's committee?" and then submit the form.

5.4 Minor in Environmental Engineering

The minor in Environmental Engineering consists of 12 units of environmental engineering coursework. At least 9 units must be selected from the following courses:

- CHEE 500R—Water Chemistry for Engineers (3 units)
- CHEE 574—Environmental Transport Processes (3 units)
- CHEE 576A—Water Treatment System Design (3 units)
- CHEE 576B—Wastewater Treatment System Design (3 units)
- CHEE 577R—Microbiology for Engineers (3 units)
- CHEE 578—Introduction to Hazardous Waste Management (3 units)
- CHEE 676—Advanced Water and Wastewater Treatment (3 units)

The additional 3 units may correspond to additional courses in the previous list or other graduate environmental engineering courses upon approval of the minor advisor. Depending on the student's background, the minor advisor might recommend preparatory undergraduate courses to be taken to cover prerequisite deficiencies.

A member from the Environmental Engineering graduate faculty will serve as minor committee member.

APPENDIX

A1. Chemical & Environmental Engineering Faculty and Staff

Faculty

| Name | Title | Phone | Office | Email |
|-----------------------|------------------------------------|--------------|----------|--|
| Achilli, Andrea | Assistant Professor | 520-621-6586 | CE 306C | achilli@arizona.edu |
| Arnold, Robert G. | Professor Emeritus | 520-621-2410 | CE 306A | rga@arizona.edu |
| Baygents, James C. | Associate Dean, Academic Affairs | 520-621-6032 | ENGR 200 | baygents@arizona.edu |
| Blowers, Paul | Distinguished Professor | 520-626-5319 | JWH 128 | blowers@arizona.edu |
| Brush, Adrianna | Lecturer | 520-626-5259 | JWH 134B | adriannabrush@arizona.edu |
| Farrell, James | Professor | 520-621-2465 | CE 306F | farrellj@arizona.edu |
| Field, James A. | Assistant Dean, Graduate Education | 520-621-0704 | ENGR 208 | jimfield@arizona.edu |
| Gervasio, Dominic | Associate Professor | 520-621-4870 | JWH 146A | gervasio@arizona.edu |
| Guzmán, Roberto | Professor | 520-621-6041 | JWH 134D | guzmanr@arizona.edu |
| Hempel, Byron | Lecturer | 520-621-6055 | JWH 105D | byronhempel@arizona.edu |
| Hickenbottom, Kerri | Assistant Professor | 520-626-9323 | CE 306E | klh15@arizona.edu |
| Karanikola, Vicky | Assistant Professor | 520-621-5881 | CE 306F | vkaranik@arizona.edu |
| Muscat, Anthony J. | Professor | 520-626-6162 | JWH 108C | muscat@erc.arizona.edu |
| Ogden, Kimberly L. | Professor / Department Chair | 520-621-9484 | JWH 120 | ogden@arizona.edu |
| Philipossian, Ara | Professor | 520-621-6101 | ECE 223 | ara@arizona.edu |
| Printz, Adam | Assistant Professor | 520-626-6769 | JWH 146C | aprintz@arizona.edu |
| Sáez, Eduardo | Distinguished Professor | 520-621-5369 | JWH 142C | esaesz@arizona.edu |
| Savagatrup, Suchol | Assistant Professor | 520-621-1266 | JWH 132 | suchol@arizona.edu |
| Shadman, Farhang | Regents' Professor | 520-621-6051 | JWH 134 | shadman@erc.arizona.edu |
| Sierra-Alvarez, Reyes | Professor | 520-626-2896 | JWH 130 | rsierra@arizona.edu |
| Snyder, Shane | Professor | 520-621-2573 | CE 306G | snyders2@arizona.edu |
| Sorooshian, Armin | Professor | 520-626-5858 | JWH 108E | armin@arizona.edu |
| Xie, Songtao | Lecturer | 520-621-3155 | JWH 105B | songtaoxie@arizona.edu |

RESEARCH FACULTY

| Name | Title | Phone | Office | Email |
|--------------|------------------------------|--------------|-------------|--|
| Ogden, Greg | Research Associate Professor | 520-621-4422 | JWH 105E | gogden@arizona.edu |
| Park, Minkyu | Research Assistant Professor | 520-820-6619 | BIO5 400A20 | minkyupark@arizona.edu |

STAFF

| Name | Title | Phone | Office | Email |
|------------------|-------------------------------|--------------|----------|--|
| Altman, Holly | Program Manager | 520-621-2591 | JWH 108 | haltman@arizona.edu |
| Camacho, Eduardo | Accountant, Sr. | 520-626-1287 | MM 141 | camacho@ag.arizona.edu |
| Durazo, Armando | Principal Research Specialist | 520-626-6748 | CE 314C | armandodurazo@arizona.edu |
| Evans, Rose | Business Manager | 520-626-1278 | MM 141 | revans@mse.arizona.edu |
| Fajardo, Dolores | Business Manager, Sr. (HR) | 520-626-1129 | MM 141 | dfajardo@email.arizona.edu |
| Fuller, Grace | Graduate Program Coordinator | 520-621-9341 | JWH 105F | gracefuller@arizona.edu |
| Huggins, Lori | Undergraduate Advisor | 520-621-1897 | JWH 105C | lhuggins@arizona.edu |
| Rodriguez, Ana | Manager, Finance and Admin. | 520-621-2415 | JWH 141 | rodrigua@arizona.edu |
| Scheyer, Lisa | Human Resources Rep | 520-626-1129 | JWH 141 | lisamscheyer@arizona.edu |
| Seiter, Myrna | Administrative Associate | 520-626=2991 | MM 141 | myrna1165@arizona.edu |

GRADUATE COLLEGE REPRESENTATIVE FOR CHEE (not part of CHEE department)

| Name | Title | Phone | Office | Email |
|------------------|---------------------------|--------------|--------|--|
| Kristi Davenport | Graduate Degree Counselor | 520-626-1930 | | kdavenport@arizona.edu |

A2. Graduate Studies Committees

CHEMICAL ENGINEERING

Adam Printz, Chair and Director of Graduate Studies

Anthony Muscat

Suchol Savagatrup

Grace Fuller

ENVIRONMENTAL ENGINEERING

Reyes Sierra, Chair and Director of Graduate Studies

Kerri Hickenbottom

Vicky Karanikola

Grace Fuller

A3. MS Non-thesis Checklist

| | |
|--|--------------------------|
| <u>Review Graduate college policies.</u> | <input type="checkbox"/> |
| Review CHEE Graduate Student Handbook. | <input type="checkbox"/> |
| <u>GradPath forms completed (please complete all GradPath forms in a timely manner.) You can get assistance by clicking on “GradPath Videos.”</u> | <input type="checkbox"/> |
| Proposal, publications and Master’s report drafts and finals submitted electronically to Committee Chair/Faculty Advisor for review prior to final submission(s). Final submitted to Graduate Program Coordinator/Advisor for filing. | <input type="checkbox"/> |
| Master’s report defense date confirmed and approved by report committee and room reserved. (Applies only to Environmental Engineering students.) | <input type="checkbox"/> |
| Provide hard copy of evaluation rubric (See Appendix A10) to each defense committee member (rubric must be completed at Defense by each member). Committee Chair returns all rubrics to Holly Altman, Program Manager. (Applies only to Environmental Engineering students.) | <input type="checkbox"/> |
| Master’s report revisions completed and approved. | <input type="checkbox"/> |
| <u>Change of K grades for CHEE 909 completed by faculty advisor (if applicable) and given to Graduate Program Coordinator/Advisor.*</u> | <input type="checkbox"/> |
| <i>* Note that Grad Advisor/Coordinator will email the above document to Grad College and submit GradPath final completion form.</i> | N/A |
| Exit survey completed. Note that the exit survey should not be completed until after you have completed your master’s report. Please contact Holly Altman at haltman@arizona.edu or Grace Fuller (gracefuller@arizona.edu) for link to survey. | <input type="checkbox"/> |
| Exit interview completed. Please contact Holly Altman at haltman@arizona.edu to schedule exit interview. | <input type="checkbox"/> |
| <i>Only do the following if you are not going on to complete your PhD here at UA. If you are going on to complete your PhD, please let the Graduate Program Coordinator/Advisor know.</i> | <input type="checkbox"/> |
| Keys turned in to Key Desk. | <input type="checkbox"/> |
| Desk cleaned out and Graduate Program Coordinator/Advisor notified that you are no longer using it. | <input type="checkbox"/> |

If all this is completed and checked off, congratulations! You did it!!

Please drop by and say good-bye to Grace and others who have helped you along your path to your MS degree, and keep in touch. If you can, come back for Homecoming. We love to hear how you are doing.

A4. MS Thesis Checklist

| | |
|---|--------------------------|
| Review Graduate college policies. | <input type="checkbox"/> |
| Review CHEE Graduate Student Handbook. | <input type="checkbox"/> |
| GradPath forms completed (please complete all GradPath forms in a timely manner.) You can get assistance by clicking on “GradPath Videos.” | <input type="checkbox"/> |
| Review defense procedures from Grad College with Committee Chair/Faculty Advisor. | <input type="checkbox"/> |
| Proposal, publications and thesis drafts and finals submitted electronically to Committee Chair/Faculty Advisor for review prior to final submission(s). Final submitted to Graduate Program Coordinator/Advisor for filing. | <input type="checkbox"/> |
| Thesis defense date confirmed and approved by thesis committee and room reserved. | <input type="checkbox"/> |
| Provide hard copy of evaluation rubric (See Appendix A10) to each defense committee member (rubric must be completed at Defense by each member). Committee Chair returns all rubrics to Holly Altman, Program Manager. | <input type="checkbox"/> |
| Committee revisions completed and approved. | <input type="checkbox"/> |
| Thesis Approval page (See Grad College sample pages) signed and dated with defense date and given to Graduate Program Coordinator/Advisor. | <input type="checkbox"/> |
| Thesis submitted electronically to Grad College by deadline. | <input type="checkbox"/> |
| Distribution rights form completed and given to Graduate Program Coordinator/Advisor.* | <input type="checkbox"/> |
| Change of K grade for CHEE 910 completed by faculty advisor (if applicable) and given to Graduate Program Coordinator/Advisor.* | <input type="checkbox"/> |
| <i>* Note that Grad Advisor/Coordinator will email both of the above docs to Grad College and submit GradPath final completion form.</i> | N/A |
| Thesis revisions requested by Graduate College completed. | <input type="checkbox"/> |
| Exit survey completed. Note that the exit survey should not be completed until after you have completed your thesis defense. Please contact Holly Altman at haltman@arizona.edu or Grace Fuller (gracefuller@arizona.edu) for link to survey. | <input type="checkbox"/> |
| Exit interview completed. Please contact Holly Altman at haltman@arizona.edu to schedule exit interview. | <input type="checkbox"/> |
| <i>Only do the following if you are not going on to complete your PhD here at UA. If you are going on to complete your PhD, please let your Academic Advisor know.</i> | |
| Keys turned in to Key Desk. | <input type="checkbox"/> |
| Desk cleaned out and Graduate Program Coordinator/Advisor notified that you are no longer using it. | <input type="checkbox"/> |

If all this is completed and checked off, congratulations! You did it!!

Please drop by and say good-bye to Grace and others who have helped you along the path to your MS, and keep in touch. If you can, come back for Homecoming. We love to hear how you are doing.

A5. PhD Checklist

| | |
|--|--------------------------|
| <u>Review Graduate college policies.</u> | <input type="checkbox"/> |
| Review CHEE Graduate Student Handbook. | <input type="checkbox"/> |
| <u>GradPath forms completed (please complete all GradPath forms in a timely manner, prior to exams and defenses.) You can get assistance by clicking on “GradPath Videos”</u> | <input type="checkbox"/> |
| <u>Review Grad College Policies and Procedures with Comp Exam Chair/Faculty Advisor.</u> | <input type="checkbox"/> |
| Comp exam completed. (Please make sure your GradPath form with date is submitted at least 2 weeks prior to your comprehensive exam date.) | <input type="checkbox"/> |
| <u>Review formatting guide required by Graduate college.</u> | <input type="checkbox"/> |
| Publications form turned in to Graduate Program Coordinator with publication(s), if applicable. Email is OK. (See Section A6 of Graduate Student Handbook for form.) | <input type="checkbox"/> |
| <u>Review defense procedures from Grad College with Committee Chair/Faculty Advisor.</u> | <input type="checkbox"/> |
| Final oral defense date announced and completed. (Submit GradPath form with date at least 2 weeks prior to your defense date.) | <input type="checkbox"/> |
| Provide hard copy of evaluation rubric (See Appendix A11) to each defense committee member (rubric must be completed at Defense by each member) at final oral defense. Committee Chair returns all rubrics to Holly Altman, Program Manager. | <input type="checkbox"/> |
| Committee revisions completed and approved. | <input type="checkbox"/> |
| <u>Dissertation submitted electronically to Graduate College by deadline.</u> | <input type="checkbox"/> |
| Dissertation Approval page (See <u>Grad College sample pages</u>) signed and dated with defense date and given to Graduate Advisor. | <input type="checkbox"/> |
| <u>Distribution rights form completed and given to Graduate Program Coordinator/Advisor.*</u> | <input type="checkbox"/> |
| <u>Change of K grades for CHEE 900 and/or 920 completed by faculty advisor (if applicable) and given to Graduate Program Coordinator/Advisor.*</u> | <input type="checkbox"/> |
| <i>* Note that Grad Advisor/Coordinator will email all three of the above docs to Grad College and submit GradPath final completion form.</i> | N/A |
| Dissertation revisions requested by Graduate College completed. | <input type="checkbox"/> |
| Exit survey completed. Note that the exit survey should not be completed until after you have completed your final oral defense. Please contact Holly Altman at haltman@arizona.edu or Grace Fuller at gracefuller@arizona.edu for link to survey. | <input type="checkbox"/> |
| Exit interview completed. Please contact Holly Altman at haltman@arizona.edu to schedule exit interview. | <input type="checkbox"/> |
| Keys turned in to Key Desk. | <input type="checkbox"/> |
| Computer/laptop turned in (if applicable). | <input type="checkbox"/> |
| Desk cleaned out and Grad Advisor notified that you are no longer using it. | <input type="checkbox"/> |

If all this is completed and checked off, congratulations! You did it!!

Please drop by and say good-bye to Grace and other who have helped you along your academic path, and keep in touch. If you can, come back for Homecoming. We love to hear how you are doing.

A6. Chemical and Environmental Engineering Advisor Selection Form

New graduate students should spend the first three weeks after arrival at the University of Arizona meeting with potential research advisors. After these meetings, students should fill out this form, scan and email it to the appropriate chair of the Graduate Studies Committee (Chemical Engineering: aprintz@arizona.edu / Environmental Engineering: rsierra@arizona.edu) no later than Friday of the third week of classes.

Student Full Name: [Click or tap here to enter text.](#)

First Choice: [Click or tap here to enter text.](#)

Second Choice: [Click or tap here to enter text.](#)

Third Choice: [Click or tap here to enter text.](#)

If you already have an advisor before the semester begins, please note the advisor's name below:

Advisor Name: [Click or tap here to enter text.](#)

Date: [Click or tap here to enter text.](#)

A7. Dissertation Committee Review Form (ChE only)

Date of Meeting: [Click or tap here to enter text.](#)

Name of PhD Candidate: [Click or tap here to enter text.](#)

Dissertation Committee members: [Click or tap here to enter text.](#)

Following successful completion of the Comprehensive Exam, each Chemical Engineering PhD Candidate must meet annually with their Dissertation Committee to discuss progress to date and, in particular, any publications that will be submitted or are in progress.

On the above-named date, we, the undersigned, met with the above-named student and are satisfied that the student has made acceptable progress toward completion of their degree, including any first-author publications submitted or in progress. Recommended next steps include: [Click or tap here to enter text.](#)

(Name), Committee Chair [Click or tap here to enter text.](#)
Date

(Name), Member [Click or tap here to enter text.](#)
Date

(Name), Member [Click or tap here to enter text.](#)
Date

(Name), Member [Click or tap here to enter text.](#)
Date

Student Signature [Click or tap here to enter text.](#)
Date

A8. PhD Publications Form

Date: [Click or tap here to enter text.](#)

Name PhD Candidate: [Click or tap here to enter text.](#)

Name(s) PhD Faculty Advisor(s): [Click or tap here to enter text.](#)

PhD students are strongly encouraged to have two peer reviewed journal publications either accepted, in press or published in peer reviewed indexed journals in order to make them more competitive employment candidates after graduation. A successful submission of a manuscript to a Journal can count toward these publications.

Publication 1

Authors: [Click or tap here to enter text.](#)

Year: [Click or tap here to enter text.](#)

Title: [Click or tap here to enter text.](#)

Journal: [Click or tap here to enter text.](#)

Volume, issue and pages: [Click or tap here to enter text.](#)

Journal's One Year Impact Factor: [Click or tap here to enter text.](#)

Publication 2

Authors: [Click or tap here to enter text.](#)

Year: [Click or tap here to enter text.](#)

Title: [Click or tap here to enter text.](#)

Journal: [Click or tap here to enter text.](#)

Volume, issue and pages: [Click or tap here to enter text.](#)

Journal's One Year Impact Factor: [Click or tap here to enter text.](#)

Attachments:

For each article, please attach reprint(s). If manuscript is in accepted or in press status, please attach correspondence with editor indicating the status or the page proofs. If you have a submission in lieu of an accepted publication please attach evidence that article has been received by the journal and that your submission conforms with journal submission requirements

Comments (optional): [Click or tap here to enter text.](#)

Approval Signatures

PhD Advisor: [Type name here](#) Signature: _____ Date: [Date here](#)

A9. Graduate Student Department Petition

Date: [Click or tap here to enter text.](#)

Student Name: [Click or tap here to enter text.](#)

Student ID Number: [Click or tap here to enter text.](#)

Mailing Address: [Click or tap here to enter text.](#)

Phone: [Click or tap here to enter text.](#) Email: [Click or tap here to enter text.](#)

Degree Program: Chemical Engineering Environmental Engineering MS PhD

Subject of Petition: [Click or tap here to enter text.](#)

Request: [Click or tap here to enter text.](#)

Reason for Request: [Click or tap here to enter text.](#)

APPROVED:

DENIED:

Approval Signature (Grad Studies or Dept. Chair): _____

Grad Studies or Dept. Chair comments: [Click or tap here to enter text.](#)

A10. Chemical and Environmental Engineering Defense Evaluation Rubric (MS)

Assessment Activity: MS Thesis or Master's Report

Student Name: [Click or tap here to enter text.](#)

Date: [Click or tap here to enter text.](#)

Committee Member: [Click or tap here to enter text.](#)

Directions: *Evaluate this student's written and verbal presentation of their research with a score between 1 and 5 for each of the criteria described below. Below each score and statement, briefly comment on the rationale if your score is less than 4. Turn in your completed rubric to the committee chair before leaving the defense.*

Score: 5–Exceptional 4–Very Good 3–Acceptable 2–Needs Improvement 1–Unacceptable

| | | | | | |
|---|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| Quality of thesis/master's report writing <u>Rationale if score below 4</u> | <input type="checkbox"/> 5 | <input type="checkbox"/> 4 | <input type="checkbox"/> 3 | <input type="checkbox"/> 2 | <input type="checkbox"/> 1 |
| Problem description and analysis of the related research literature <u>Rationale if score below 4</u> | <input type="checkbox"/> 5 | <input type="checkbox"/> 4 | <input type="checkbox"/> 3 | <input type="checkbox"/> 2 | <input type="checkbox"/> 1 |
| Research design <u>Rationale if score below 4</u> | <input type="checkbox"/> 5 | <input type="checkbox"/> 4 | <input type="checkbox"/> 3 | <input type="checkbox"/> 2 | <input type="checkbox"/> 1 |
| Data analysis <u>Rationale if score below 4</u> | <input type="checkbox"/> 5 | <input type="checkbox"/> 4 | <input type="checkbox"/> 3 | <input type="checkbox"/> 2 | <input type="checkbox"/> 1 |
| Soundness of conclusions and quality of responses to challenges to candidate's interpretations and conclusions <u>Rationale if score below 4</u> | <input type="checkbox"/> 5 | <input type="checkbox"/> 4 | <input type="checkbox"/> 3 | <input type="checkbox"/> 2 | <input type="checkbox"/> 1 |
| Understanding of the broader implications of candidate's research <u>Rationale if score below 4</u> | <input type="checkbox"/> 5 | <input type="checkbox"/> 4 | <input type="checkbox"/> 3 | <input type="checkbox"/> 2 | <input type="checkbox"/> 1 |
| Ability to anticipate the logical next level of inquiry <u>Rationale if score below 4</u> | <input type="checkbox"/> 5 | <input type="checkbox"/> 4 | <input type="checkbox"/> 3 | <input type="checkbox"/> 2 | <input type="checkbox"/> 1 |

A11. Chemical and Environmental Engineering Defense Evaluation Rubric (PhD)

Assessment Activity: PhD Dissertation & Defense

Student Name: [Click or tap here to enter text.](#)

Date: [Click or tap here to enter text.](#)

Dissertation Committee Member: [Click or tap here to enter text.](#)

Directions: *Evaluate this student's written and verbal presentation of their research with a score between 1 and 5 for each of the criteria described below. Below each score and statement, briefly comment on the rationale if your score is less than 4. Turn in your completed rubric to the committee chair before leaving the defense.*

Score: 5–Exceptional 4–Very Good 3–Acceptable 2–Needs Improvement 1–Unacceptable

| | | | | | |
|---|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| Quality of dissertation writing <u>Rationale if score below 4</u> | <input type="checkbox"/> 5 | <input type="checkbox"/> 4 | <input type="checkbox"/> 3 | <input type="checkbox"/> 2 | <input type="checkbox"/> 1 |
| Problem description and analysis of the related research literature <u>Rationale if score below 4</u> | <input type="checkbox"/> 5 | <input type="checkbox"/> 4 | <input type="checkbox"/> 3 | <input type="checkbox"/> 2 | <input type="checkbox"/> 1 |
| Research design <u>Rationale if score below 4</u> | <input type="checkbox"/> 5 | <input type="checkbox"/> 4 | <input type="checkbox"/> 3 | <input type="checkbox"/> 2 | <input type="checkbox"/> 1 |
| Data analysis <u>Rationale if score below 4</u> | <input type="checkbox"/> 5 | <input type="checkbox"/> 4 | <input type="checkbox"/> 3 | <input type="checkbox"/> 2 | <input type="checkbox"/> 1 |
| Soundness of conclusions and quality of responses to challenges to candidate's interpretations and conclusions <u>Rationale if score below 4</u> | <input type="checkbox"/> 5 | <input type="checkbox"/> 4 | <input type="checkbox"/> 3 | <input type="checkbox"/> 2 | <input type="checkbox"/> 1 |
| Understanding of the broader implications of candidate's research <u>Rationale if score below 4</u> | <input type="checkbox"/> 5 | <input type="checkbox"/> 4 | <input type="checkbox"/> 3 | <input type="checkbox"/> 2 | <input type="checkbox"/> 1 |
| Ability to anticipate the logical next level of inquiry <u>Rationale if score below 4</u> | <input type="checkbox"/> 5 | <input type="checkbox"/> 4 | <input type="checkbox"/> 3 | <input type="checkbox"/> 2 | <input type="checkbox"/> 1 |