



**Department of Chemical and Environmental
Engineering**

CHEMICAL AND ENVIRONMENTAL ENGINEERING

GRADUATE STUDENT HANDBOOK

2015-2016

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1. Introduction

This Graduate Handbook is intended to help you on your path through the Department's advanced degree program 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 and Environmental Engineering: Master of Science (M.S.) with and without a thesis (M.S. Thesis and M.S. Non-Thesis), and the Doctor of Philosophy (Ph.D.). Both programs also offer an Accelerated Master's Program (AMP) leading to a M.S. Non-Thesis degree or a M.S. Thesis degree. The M.S. Non-Thesis degree is intended for students who are seeking a broader education, while the M.S. Thesis degree is intended for students who additionally want to work closely with a faculty member on a research topic. The Ph.D. degree is intended for students aiming to broaden their education and get deeper into a research topic as compared to what a M.S. degree is designed for.

Graduates of each of these degrees will be trained to seek employment in a number of different sectors such as industry, national laboratories, and consulting firms. Ph.D. graduates will additionally be prepared for seeking postdoctoral research positions and academic positions in universities. Graduates in both chemical and environmental engineering will be suitable for positions in a variety of topics due to the diversity of the knowledge gained in these 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). Students must follow the guidelines described below for specific degree programs. Developing and maintaining an early working relationship with an advisor, who is responsible for mentoring, is extremely important. Students who for some reason do not complete these explicit processes for project and advisor selection on time must meet with the Graduate Study Committee (GSC) for their respective program to discuss whether they can remain in the graduate program. 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 student.

The GSC 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 GSC and Department Chair based on student preferences, 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.

3.2 Satisfactory Academic Progress

Students must consult with both their research advisor and 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. The student is expected to work with these two mentors to improve their academic standing.

3.3 Selection of Project and Advisor

Upon arrival on campus, new graduate students should contact the chair of the GSC to discuss getting started on the selection of projects and major professors. In general, new students who are supported by departmental research assistantships meet only with faculty members who have research projects with supported student positions available. Self-supported students or students with fellowship support should meet with all faculty members that have available research projects. 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 a specific date specified by the GSC, new students should provide his/her first, second, and third choices for a faculty advisor on specific form available in the department office. This form must be returned to the GSC.

3.4 Help with Academic Issues

In most circumstances, you should first pose questions on academic matters to your thesis or dissertation advisor. Other members of your committee should also provide guidance and mentoring. The Graduate Study Committees can help with advice especially on curriculum questions and deadlines. You may also contact the Department Chair at any time concerning issues related to your 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. This is available on-line through D2L. Please submit a copy of your certificate to your advisor and to Holly Altman (haltman@email.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.

- a. Academic Integrity: <http://deanofstudents.arizona.edu/codeofacademicintegrity>
- b. Responsible Conduct of Research: <http://www.orcr.arizona.edu/>
- c. Student Conduct: <http://deanofstudents.arizona.edu/studentcodeofconduct>
- d. [Graduate College Policies & Procedures: https://grad.arizona.edu/policies](https://grad.arizona.edu/policies)

3.7 Departmental Graduate Seminar

All full-time graduate students enrolled in the chemical engineering or environmental engineering graduate program are required to register for 1 seminar unit (CHEE 696A) each semester **unless it conflicts with another course**. This is required even if they have satisfied the seminar requirements for their degree. All graduate students in residence are required to attend the departmental seminar if course schedules permit.

3.8 Teaching Assistantships and Other Funding Opportunities

Teaching assistantships are awarded/assigned by the GSC each semester. Priority is given to 2nd – 4th year PhD students. All students must have the appropriate background for the course for which they will TA (e.g., they may have taken an equivalent course as an undergraduate). Faculty mentors nominate graduate students for TA positions. 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>.

Additional funding opportunities for graduate students are administered or funded 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](#).

3.9 Degree Requirements, Timelines and Deadlines

There are four graduate degrees offered by the Department of Chemical and Environmental Engineering: PhD in Chemical Engineering, MS in Chemical Engineering, PhD in Environmental Engineering, and MS in Environmental Engineering. Subsequent sections describe the particular requirements for each of these degree paths. Your advisor, other members of your committee, the members of the graduate study 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 your most reliable source. Please be sure to get to know her.

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. Make sure that you follow the specific instructions provided on the following pages:

[-http://catalog.arizona.edu/](http://catalog.arizona.edu/)

[-https://grad.arizona.edu/gsas/degree-requirements](https://grad.arizona.edu/gsas/degree-requirements)

All Ph.D and MS students must submit GradPath forms to the Graduate College electronically. Please review the Graduate College information carefully and be cognizant of deadlines.

From this last website you can navigate to find the following two links that provide important information about important dates/deadlines and resources for parents, professional development, and health/wellness:

[-http://grad.arizona.edu/new-and-current-students](http://grad.arizona.edu/new-and-current-students)

[-http://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines](http://grad.arizona.edu/gsas/degree-requirements/important-degree-dates-and-deadlines)

3.10 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 Graduate College: <https://grad.arizona.edu/policies/academic-policies/grievance-policy>.

4. Degree Requirements: Chemical Engineering

	PhD	Thesis MS	Non-thesis MS
Required Courses (502, 505, 506, 530)	12	12	12
PhD Required Course (503)	3		
Electives (including minor)	15	12	15
Seminar 696A	8	1	
CHEE 909 or CHEE 594			3
MS Thesis		5	
Dissertation (CHEE 920)	22		
Research Independent of Dissertation (CHEE 900)	3		
Total	63	30	30

The Graduate College website also summarizes this information at: <https://grad.arizona.edu/programs/>
For more information about the Accelerated Master Program (AMP) leading to the Non-Thesis MS degree, please refer to this website and select the pdf file under the tab labeled “[Accelerated MS Degrees](#)”.

Descriptions for the courses shown in subsequent pages can be found at this website: <http://www.chee.arizona.edu/graduates-course-descriptions>

4.1 Ph.D. Program (Chemical Engineering)

4.1.1 Course Requirements

	Fall	Spring
Year 1	CHEE 502 (3) – Advanced Engineering Analysis CHEE 505 (3) – Advanced Chemical Engineering Transport Phenomena CHEE 506 (3) – Advanced Chemical Engineering Thermodynamics CHEE 696A (1) – Graduate Seminar CHEE 900 (1) - Research Independent of Dissertation <i>Students should have an assigned research advisor by end of this semester.</i>	CHEE 530 (3) – Chemical Reaction Engineering Elective (3) Elective (3) CHEE 696A (1) – Graduate Seminar CHEE 900 (1) – Research Independent of Dissertation CHEE 920 (1) – Dissertation Research <i>A student with GPA < 3.75 in the four core courses (520/505/506/530) must take the written qualification exam in August. The exam is waived for GPA ≥ 3.75.</i>
Year 2	Elective (3) Elective (3) CHE 696A (1) – Graduate Seminar CHEE 920 (5) – Dissertation Research <i>Students should file their “Plan of Study”</i>	Elective (3) CHEE 503 (3) – Oral and written communication CHEE 696A (1) – Graduate Seminar CHEE 920 (5) – Dissertation Research <i>All students take the Comprehensive exam: (i) write thesis proposal; (ii) orally defend thesis proposal by the beginning of the next fall semester.</i>
Year 3	CHEE 696A (1) – Graduate Seminar CHEE 920 (11) – Dissertation Research <i>Students who pass the Comprehensive exam should plan to TA at least one semester.</i>	CHEE 696A (1) – Graduate Seminar CHEE 900 (1) – Research Independent of Dissertation CHEE 920 (10) – Dissertation Research
Year 4	CHEE 696A (1) – Graduate Seminar CHEE 920 (11) – Dissertation Research	CHEE 696A (1) – Graduate Seminar CHEE 920 (11) – Dissertation Research

Thirty-six units of coursework are required for the major subject, exclusive of dissertation research. Eight units of seminar (CHEE 696A) and 22 units of dissertation (CHEE 920) will be used as requirements for the PhD degree.

In addition to core courses (CHEE 520/503/505/506/530), students who enter the PhD program without an MS in chemical engineering must take 15 units of electives (which includes the minor), and 8 units of departmental seminar (CHEE 696A), and 3 units of ChEE 900. All core and elective courses must be in courses in which regular grades (A, B or C) have been earned. Students who enter the PhD program with an MS may transfer up to 12 units of coursework after approval from the Graduate College, and will be evaluated individually to devise a Plan of Study.

4.1.2 Qualifying Examination

The PhD Qualifying Examination is a written exam, given in August of the 2nd year before the semester starts. The exam is over 2 days and the subjects evaluated are Transport Phenomena, Thermodynamics, Reaction Engineering and Applied Mathematics. The material evaluated will be a mixture of graduate and undergraduate material. The written qualifying exam is waived for students with a GPA of 3.75 and above in the core courses ChEE 502, 505 506, and 530. Students entering with a BS in Chemical Engineering must take the exam the first time it is offered. For 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. A student failing only one part can retake that one part and those failing two or more parts must retake the entire exam; the retake will be offered in the subsequent December. If the student fails any part of the exam again, then the student will have failed the written qualification exam and be put on the MS track.

Transfer students from United States universities will be evaluated individually to devise plans for courses and the written qualification exam.

4.1.3 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 the research advisor. Minors are administered and approved by the minor department. They typically consist of 9 to 12 units of course work. These units are part of the 15 elective units mentioned in the Course Requirements Section.

4.1.4 Plan of Study

In conjunction with his/her advisor, each student is responsible for developing a Plan of Study, to be filed with the Graduate College during the semester 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, which the student intends to apply toward the graduate degree; and (3) additional course work to be completed in order to fulfill degree requirements. 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. Please be cognizant of the deadline to submit your GradPath Plan of Study for review.

4.1.5 Comprehensive Examination

Before admission to candidacy for the doctoral degree, the student must pass both the written Qualifying Examination and an Oral PhD 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 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 adjunct appointments. The GSC forms the thesis committee in consultation with the faculty.

The Comprehensive Examination must be completed in the Spring semester following completion of the Qualifying Examination (i.e. 4th semester). The written part of the Comprehensive examination will be a research proposal that will be prepared as part of the CHEE 503, which is a course that focuses on oral and written communication. Students must take this 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 in which the student must demonstrate breadth in chemical engineering and their minor field of study. The oral part of the examination must be completed before the beginning of their 5th semester in residency (i.e. Fall semester of 3rd year). Students should be aware that they need to complete most of their coursework (i.e. at least 27 of the 30 graded units of core course and elective units) to be eligible to take the comprehensive examination. Recall that these 30 graded units (A/B/C/D/E system) are comprised of the core CHEE courses (502/503/505/506/530) and 5 elective courses that include those for the minor. 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.

4.1.6 Annual Interaction with Thesis Committee

The overall goal is for students to complete their PhD degrees in 4 years. Hence, in the years after Completion of the Comprehensive Examination (Years 3, 4) all PhD candidates will register for one unit of ChEE 900 in the spring semester. To complete the course, the candidate must have a meeting with his/her committee and discuss progress towards degree completion. 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 the publications that will be submitted or are in progress.

4.1.7 Publication Requirement

PhD students must have two publications either accepted, in press or published in peer-reviewed, indexed journals. These publications should form a major part of the dissertation. Copies of the publications must be submitted to the department chair, along with the Publication Compliance Form, available in the department's office, before the final oral examination is scheduled. In exceptional circumstances, a successful submission of a manuscript to a peer-reviewed journal can be counted as one of the required publications.

4.1.8 Final Oral 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 should 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 same dissertation committee. Committee members representing the minor program must be invited to the defense, but their participation is optional. You must submit an announcement of your final Oral Defense via GradPath at least two weeks before your defense.

4.2 M.S. Program (Chemical Engineering)

There are two MS degree options:

1. Thesis MS

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 should be submitted to the GSC. The examination focuses on the research. The examining committee will consist of the MS Thesis Committee. All members of the committee should be present during the examination while the presence of additional committee members is optional.

2. Non-thesis MS

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 in the summer.

4.2.1 Course Requirements for Thesis M.S.

	Fall	Spring
Year 1	CHEE 502 (3) – Advanced Engineering Analysis CHEE 505 (3) – Advanced Chemical Engineering Transport Phenomena CHEE 506 (3) – Advanced Chemical Engineering Thermodynamics CHEE 696A (1) – Graduate Seminar CHEE 910 (2) - MS Thesis Research <i>Students should have an assigned research advisor by end of this semester.</i>	CHEE 530 (3) – Chemical Reaction Engineering Elective (3) Elective (3) CHEE 910 (3) - MS Thesis Research
Year 2	Elective (3) Elective (3) CHEE 910 (3) – MS Thesis Research <i>All students write thesis proposal and orally defend it by end of semester.</i>	

4.2.2 Course Requirements for Non-thesis MS

	Fall	Spring
Year 1	CHEE 502 (3) – Advanced Engineering Analysis CHEE 505 (3) – Advanced Chemical Engineering Transport Phenomena CHEE 506 (3) – Advanced Chemical Engineering Thermodynamics Elective (3)	CHEE 530 (3) – Chemical Reaction Engineering Elective (3) Elective (3) Elective (3)
Year 2	Elective (3) CHEE 909 (3-MS Report) or CHEE 594 (3-Practicum)	

4.3 Accelerated M.S. 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 UA 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 chemical engineering at the UA.

4.3.2 How to apply

In early January of the junior year, students submit an online application to the Graduate College, specifying chemical engineering as major subject. The student will also have the opportunity to indicate explicitly that the application is for AMP ChE. After acceptance to the AMP program, students register during their senior (fourth) year to take a combination of undergraduate and graduate courses. These courses will serve both as electives for the B.Sc. degree and as core or elective courses for the MS. In the fifth and final year, students focus on graduate course work and their thesis or project.

4.3.4 Eligibility criteria

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

- Be a continuing University of Arizona undergraduate.
- Have a minimum cumulative GPA of 3.3.

- 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 UA's main campus.

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

4.3.5 UA 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 B.Sc. and the M.S. degrees. Students will be charged at the undergraduate rate and retain eligibility for undergraduate scholarships. After completion of all B.Sc. 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 and coded as "graduate" in SIS. They will no longer be eligible for undergraduate scholarships. Nor will they be eligible for graduate assistantships. At least 12 graduate units must be taken while in graduate status, after completing all degree requirements for the B.Sc. A total of 30 graduate credits (500 or higher) should be taken.

Students should complete their undergraduate requirements no later than one semester before receiving their MS.

4.3.6 Program requirements and guidelines

After admission into the AMP ChE program, students must select an advisor who will guide the student's research or development work towards the completion of a thesis or master's report. Writing a thesis or a report project is required. CHEE 400 level courses that are convened with 500 level courses can be taken as electives for both the BSc and the AMP programs – the 500 version of the course must be taken in this case. Exceptions are CHEE 420/520 and 477R/577R. These are required undergraduate courses and the 400 version must be taken. The AMP ChE can be either thesis or non-thesis and will follow the same requirements of the regular MS program.

Sample plans for both version of the AMP ChE (thesis or non-thesis) are shown below.

Sample Plan 1: BS in ChE and AMP in ChE (non-thesis)

Semester 1	Units	Semester 2	Units
ENGR 102	3	ECE 175	3
MATH 125 or 124 [#]	3/5	CHEM 152	4
CHEM 151	4	MATH 129	3
ENGL 101	3	ENGL 102	3
Tier 1 INDV*	3	Tier 1 INDV*	3
Total	16/18	Total	16
Semester 3	Units	Semester 4	Units
CHEE 201	3	CHEE 202	4
CHEE 201L	1	CHEE 203	3
MATH 223	4	PHYS 241	4
PHYS 141	4	MATH 254	3
CHEM 241a	3	CHEM 241b	3
CHEM 243a	1		
Tier 1 TRAD*	3		
Total	19	Total	17
Semester 5	Units	Semester 6	Units
CHEE 303	3	CHEE 305	3
CHEE 402	3	CHEE 326	3
CHEE 477R***	3	Science Elective†	3
CHEM 480a	3	Technical Requirement**	3
Tier 1 TRAD*	3	Tier 2 INDV*	3
CHEE 301a	1	CHEE 301b	1
Total	16	Total	16
Semester 7	Units	Semester 8	Units
CHEE 420***	3	CHEE 413	3
CHEE 442	3	CHEE 443	3
CHEE 401a	1	Grad/undergrad elective††	3
CHEE 502	3	Grad/undergrad elective††	3
Grad/undergrad elective††	3	Tier 2 Art/Hum*	3
Total	13	Total	15
Semester 9	Units	Semester 10	Units
CHEE 505	3	CHEE 530	3
CHEE 506	3	CHEE 574	3
Grad elective‡	3	CHEE 909	3
Total	9	Total	9
Total BS/ChE	128	Total MS/ChE	30

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

Semester 1	Units	Semester 2	Units
ENGR 102	3	ECE 175	3
MATH 125 or 124 [#]	3/5	CHEM 152	4
CHEM 151	4	MATH 129	3
ENGL 101	3	ENGL 102	3
Tier 1 INDV*	3	Tier 1 INDV*	3
Total	16/18	Total	16
Semester 3	Units	Semester 4	Units
CHEE 201	3	CHEE 202	4
CHEE 201L	1	CHEE 203	3
MATH 223	4	PHYS 241	4
PHYS 141	4	MATH 254	3
CHEM 241a	3	CHEM 241b	3
CHEM 243a	1		
Tier 1 TRAD*	3		
Total	19	Total	17
Semester 5	Units	Semester 6	Units
CHEE 303	3	CHEE 305	3
CHEE 402	3	CHEE 326	3
CHEE 477R***	3	Science Elective†	3
CHEM 480a	3	Technical Requirement**	3
Tier 1 TRAD*	3	Tier 2 INDV*	3
CHEE 301a	1	CHEE 301b	1
Total	16	Total	16
Semester 7	Units	Semester 8	Units
CHEE 420***	3	CHEE 413	3
CHEE 442	3	CHEE 443	3
CHEE 401a	1	Grad/undergrad elective††	3
CHEE 502	3	Grad/undergrad elective††	3
Grad/undergrad elective††	3	Tier 2 Art/Hum*	3
Total	13	Total	15
Semester 9	Units	Semester 10	Units
CHEE 505	3	CHEE 530	3
CHEE 506	3	CHEE 574	3
CHEE 910	2	CHEE 910	3
CHEE 696A	1		
Total	9	Total	9
Total BS/ChE	128	Total MS/ChE	30

Notes:

MATH 124 is a 5 unit version of MATH 125.

* INDV/TRAD courses must meet University general education requirements.

** Technical requirement: Complete 3 units from CE 214, ECE 207, MSE 331R, ENGR 211C, E, I, M and R.

*** The 500 version of these courses should not be taken since it will not count for graduate credit.

† Science elective: complete one course from CHEM 480b, 481, 462b; or BME 510, 511. If the choice is CHEM 462b, student must file a petition to replace CHEE 477R by CHEM 462a, which is a prerequisite for CHEM 462b. BME 510 and 511 require a GPA greater than 3. If used as the science elective, BME 510 or 511 cannot be used as graduate credit.

†† These are 500-level courses. Up to two of the electives can be from Math or Science graduate programs. At least one of the electives must be from an Engineering graduate program; 400/500 level courses are acceptable (in this case, students must take the 500 version).

‡ Any 500 or 600 level course in Math, Science or Engineering.

4.4 Minor in Chemical Engineering

Twelve units of courses are required. At least 6 units must come from the following core courses of the chemical engineering graduate program:

CHEE 502
CHEE 505
CHEE 506
CHEE 530

The other 6 units must come from courses in the previous or the following lists:

CHEE 500R
CHEE 551
CHEE 520 (only for students without a chemical engineering BSc degree)
CHEE 537
CHEE 571
CHEE 581A
CHEE 581B
CHEE 574
CHEE 605

A member from the chemical engineering graduate faculty (<http://grad.arizona.edu/live/programs/description/35>) will serve as minor committee member.

5. Degree Requirements: Environmental Engineering

	PhD ¹	MS Thesis	MS Non-Thesis
Required Courses (500R, 500L, 574, 576A&B, 577R, 676)	19	19	19
Electives ²	18 ³	6	6
Seminar (CHEE 696A)	8	1	1
MS Thesis (CHEE 910)		4	
MS Report (CHEE 909)			4
Dissertation (CHEE 920)	18		
Total	63	30	30

¹Students 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.

²Some examples of possible electives: ChEE 525 “*Emerging Issues in Water Quality*”, ChEE 573 “*Biodegradation of Organic Compounds*”, ChEE 574 “*Bioremediation of Inorganic Compounds*”; ChEE 578 “*Hazardous Waste Management*”, ChEE 482/582 – *Analysis of Emerging Environmental Contaminants*, ChEE 510 - *Logistics of Writing a Manuscript for the Chemical and Environmental Engineering*, ChEE 569A “*Air Pollution*”; ChEE 696c “*Topics in Mine Reclamation and Environmental Management Seminar-based Course*”.

³ Including minor courses. Requirements dictated by minor Department.

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For more information about the Accelerated Master Program (AMP) leading to the Non-Thesis MS degree, please refer to this website and select the pdf file under the tab labeled “[Accelerated MS Degrees](#)”.

Descriptions for the courses shown in subsequent pages can be found at this website:
<http://www.chee.arizona.edu/graduates-course-descriptions>

5.1 Ph.D. Program (Environmental Engineering)

5.1.1 Course Requirements

With Prior MS If an approved MS degree is completed (at the UA or elsewhere) prior to entering the doctoral program, a minimum of 12 units of coursework must be completed beyond the MS degree requirements. An approved minor must be completed. The required coursework in the minor may be included in the 12 unit requirement. In addition, 18 units of dissertation and 8 units of seminar must be completed.

Without Prior MS A minimum of 25 units of approved coursework in the major area and 12 units of approved electives must be completed. An approved minor must be completed. Coursework for the minor may be included in the 12 unit electives requirement. In addition, 18 units of dissertation and 8 units of seminar experience must be completed.

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)

5.1.2 Qualifying Examination

The 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 Qualifying Examination is waived for students with a core course GPA ≥ 3.75 . Students must take the exam the first time it is offered. A student failing the Qualifying Examination can retake it once provided that their advisor agrees. If consent is obtained, a student failing only one part can retake that one part and those failing two or more parts must retake the entire exam; the retake will be offered three months after the student is informed of the grade obtained in the initial Examination. If the student fails any part of the exam again, then the student will have failed the written qualification exam and will be put on the MS track. The Qualifying Examination should be taken at the end of the second academic year or earlier. For 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.

5.1.3 Choice of Minor

All PhD students must fulfill the requirements for a minor in a program approved by the candidate and their dissertation advisor. Minor requirements are administered and approved by the minor department. They typically consist of 9 to 12 units of course work.

5.1.4 Plan of Study

In conjunction with his/her 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 which the student intends to apply toward the graduate degree; and (3) additional course work to be completed in order to fulfill degree requirements. The Plan of Study must have the approval of the student's Dissertation Advisor, minor advisor, and the Chair of the Environmental Engineering GSC before it is submitted to the Graduate College. The Graduate College recommends that students submit their Plan of Study in the second semester (MS students) and third semester (PhD students) in residence at University of Arizona.

5.1.5 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 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 normal research article format and font). The written document, after approval by the Dissertation 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 successfully prior to undertaking the oral 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 has confirmed completion of the required courses on the approved doctoral Plan of Study, the student will advance to doctoral candidacy.

5.1.6 Timeline for Comprehensive Examination and Requirements

The written and oral portions of the comprehensive examination must take place at least six months prior to the Final Oral Examination (defense of 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 Program of Study with the Graduate Study Committee
- Satisfy all requirements stipulated by the minor department or program
- Complete all required courses, and a minimum of 90% of *all* course work
- Complete the Written Comprehensive Examination as described above
- Take and successfully pass the Oral Comprehensive Examination.

5.1.7 Dissertation Committee

The 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 dissertation director and two other members of the Chemical and Environmental Engineering Department faculty. Additional committee members may be an eligible member of the ChEE department, the candidate's minor department, another UA department faculty or be a specially approved member from outside the UA faculty. Students must submit the names of their doctoral committee to GradPath.

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, he or she must file a Doctoral Dissertation Committee Appointment form in 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 dissertation director 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.

5.1.8 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. 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 previously described.

5.1.9 Publication Requirement

PhD students must have two publications either accepted, in press or published in peer-reviewed, indexed journals. These publications should form a major part of the dissertation. Copies of the publications must be submitted to the department chair, along with the Publication Compliance Form, available in the department's office, before the final oral examination is scheduled. In exceptional circumstances, submission of a manuscript to a peer-reviewed journal can be counted as one of the required publications.

5.1.10 Typical Ph.D. Environmental Engineering Coursework Schedule

Fall Semester - Year 1

CHEE 500R (3)

CHEE 500L (1)

CHEE 577R (3)

CHEE 576A (3)

CHEE 696A (1)

CHEE 920 (1)

Spring Semester - Year 1

CHEE 574 (3)

CHEE 576B (3)

Elective or Minor (3)

CHEE 696A (1)

CHEE 920 (2)

Fall Semester - Year 2

Electives and/or Minor (variable)

CHEE 920 (variable)

CHEE 696A (1)

Spring Semester - Year 2

CHEE 676 (3)

Electives and/or Minor (variable)

CHEE 920 (variable)

CHEE 696A (1)

Fall & Spring Semesters - Year 3 until completion

Electives and/or Minor (variable)

CHEE 920 (variable)

CHEE 696A (1)

5.2 M.S. Program (Environmental Engineering)

5.2.1 Course Requirements

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

CHEE 500R, Water Chemistry for Engineers
CHEE 500L Environmental Engineering Laboratory
CHEE 574, Environmental Transport Processes
CHEE 576A, Water Treatment System Design
CHEE 576B, Wastewater Treatment System Design
CHEE 577R, Microbiology for Engineers
CHEE 676, Advanced Water and Wastewater Treatment

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, Seminar (1 unit)
Approved Electives (6 units)

Non-Thesis 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, Masters Report (4 units)
CHEE 696A, Seminar (1 unit)
Approved Electives (6 units)

5.2.2 Plan of Study

In conjunction with the advisor, each student must file a Plan of Study with the Graduate College during the second semester of residence. The Plan of Study identifies (1) courses the student intends to transfer from other institutions; (2) courses already completed at The University of Arizona which the student intends to apply toward the graduate degree; and (3) additional course work to be completed in order to fulfill degree requirements. The Plan of Study must have the approval of the student's advisor and the chair of the Environmental Engineering GSC before it is submitted to the Graduate College via GradPath. Please be cognizant of the deadline to submit your GradPath Plan of Study for review.

5.2.3 Selection of Thesis Committee

After completion of the plan of study, it is the responsibility of the student and their thesis advisor to select a Thesis Committee. The Thesis Committee will consist of the thesis director 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.

5.2.4 Final Oral Presentation and Oral Defense Examination

M.S. Thesis: Upon the 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.

M.S. 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.

5.2.5 Typical MS Environmental Engineering Coursework Schedule

Fall Semester - Year 1

CHEE 500R (3)
CHEE 500L (1)
CHEE 577R (3)
CHEE 576A (3)
CHEE 696A (1)
Report or Thesis (1)

Spring Semester - Year 1

CHEE 574 (3)
CHEE 576B (3)
Elective (3)
CHEE 696A (1)
Report or Thesis (2)

Fall Semester - Year 2

Electives (variable)
Report or Thesis (variable)
CHEE 696A (1)

Spring Semester - Year 2

CHEE 676 (3)
Electives (variable)
Report or Thesis (variable)
CHEE 696A (1)

5.3 Accelerated M.S. Program (AMP Environmental Engineering)

5.3.1 Overview

The Accelerated Master's Program in Chemical Engineering (AMP EnvE) is a program designed to enable advanced UA undergraduate students to complete both the Bachelor of Science degree and the Master of Science degree in EnvE 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) soil, water and environment science at the U of A.

5.3.2 How to apply

In early January of the junior year, students submit an online application to the Graduate College, specifying environmental engineering as major subject. The student will also have the opportunity to indicate explicitly that the application is for AMP EnvE. After acceptance to the AMP program, students register during their senior (fourth) year to take a combination of undergraduate and graduate courses. These courses will serve both as electives for the BS degree and as core or elective courses for the MS. 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 EnvE, students must:

- Be a continuing University of Arizona undergraduate.
- Have a minimum cumulative GPA of 3.3.
- 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 students major at University of Arizona's main campus.

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

5.3.4 UA 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 B.Sc. 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 and coded as “graduate” in SIS (Student Information Systems). They will no longer be eligible for undergraduate scholarships. Nor will they be eligible for graduate assistantships.

At least 12 graduate units must be taken while in graduate status, after completing all degree requirements for the BS. A total of 30 graduate credits (500 or higher) should be taken.

Students should complete their undergraduate requirements no later than one semester before receiving their MS.

5.3.5 Program requirements and guidelines

After admission into the AMP EnvE program, students must select an advisor who will guide the student’s research or development work towards the completion of a thesis or master’s report. Writing a thesis or a report project is required.

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

Chemical Engineering BS students should take the 400 version of CHEE 420/520 and 477R/577R. These two courses are required for the Chemical Engineering BS program and, therefore, the 500 version will not count towards the AMP.

The AMP EnvE can be either thesis or non-thesis and will follow the same requirements of the regular MS program.

Sample plans for both versions of the AMP EnvE (thesis or non-thesis) are shown below.

Sample Plan 1: BS in ChE and AMP in EnvE

Semester 1	Units	Semester 2	Units
ENGR 102	3	ECE 175	3
MATH 125 or 124 [#]	3/5	CHEM 152	4
CHEM 151	4	MATH 129	3
ENGL 101	3	ENGL 102	3
Tier 1 INDV*	3	Tier 1 INDV*	3
Total	16/18	Total	16
Semester 3	Units	Semester 4	Units
CHEE 201	3	CHEE 202	4
CHEE 201L	1	CHEE 203	3
MATH 223	4	PHYS 241	4
PHYS 141	4	MATH 254	3
CHEM 241a	3	CHEM 241b	3
CHEM 243a	1		
Tier 1 TRAD*	3		
Total	19	Total	17
Semester 5	Units	Semester 6	Units
CHEE 303	3	CHEE 305	3
CHEE 402	3	CHEE 326	3
CHEE 477R***	3	Science Elective†	3
CHEM 480a	3	Technical Requirement**	3
Tier 1 TRAD*	3	Tier 2 INDV*	3
CHEE 301a	1	CHEE 301b	1
Total	16	Total	16
Semester 7	Units	Semester 8	Units
CHEE 420***	3	CHEE 413	3
CHEE 442	3	CHEE 443	3
CHEE 401a	1	Grad/undergrad elective††	3
CHEE 502	3	Grad/undergrad elective††	3
Grad/undergrad elective††	3	Tier 2 Art/Hum*	3
Total	13	Total	15
Semester 9	Units	Semester 10	Units
CHEE 500R/L	4	CHEE 676	3
Graduate elective††	3	CHEE 574	3
CHEE 910 (909 for non-thesis)	1	CHEE 910 (909 for non-thesis)	3
CHEE 696A	1		
Graduate elective††	3		
Total	12	Total	9
Total BS/ChE	128	Total MS/EnvE	30

Notes:

MATH 124 is a 5 unit version of MATH 125.

* INDV/TRAD courses must meet University general education requirements.

** Technical requirement: Complete 3 units from CE 214, ECE 207, MSE 331R, ENGR 211C, E, I, M and R.

*** The 500 version of these courses should not be taken since it will not count for graduate credit.

† Science elective: complete one course from CHEM 480b, 481, 462b; or BME 510, 511. If the choice is CHEM 462b, student must file a petition to replace CHEE 477R by CHEM 462a, which is a prerequisite for CHEM 462b. BME 510 and 511 require a GPA greater than 3. If used as the science elective, BME 510 or 511 cannot be used as graduate credit.

†† These are 500-level courses. The courses **CHEE 576A** (offered in the Fall) and **CHEE 576B** (offered in the Spring) are required for the MS degree. Examples of electives include CHEE 578 and CHEE 573, among many others. Up to two of the electives can be from Math or Science graduate programs.

Note for Civil Engineering BS students and Soil, Water and Environmental Science BS students: The courses **CHEE 577R** (offered in the Fall), **CHEE 576A** (offered in the Fall) and **CHEE 576B** (offered in the Spring) are required for the MS degree.

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 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 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 Personnel

FACULTY

	TITLE	PHONE	OFFICE	EMAIL
Arnold, Robert G.	Professor	621-2410	CE 306A	rga@engr.arizona.edu
Baygents, James C.	Assoc. Professor, Assoc. Dean	235-9856	JWH 142B	jcb@email.arizona.edu
Blowers, Paul	Professor	626-5319	JWH 105E	blowers@email.arizona.edu
Farrell, James	Professor	621-2465	CE 306C	farrell@email.arizona.edu
Field, James A.	Professor, Assistant Dean	621-6162	JWH 108	jimfield@email.arizona.edu
Guzman, Roberto	Professor	621-6041	JWH 146A	guzmanr@email.arizona.edu
Muscat, Anthony J.	Professor, Department Chair	626-6580	JWH 134	muscat@erc.arizona.edu
Ogden, Kimberly L.	Professor	621-9484	JWH 108C	ogden@erc.arizona.edu
Philipossian, Ara	Professor	621-6101	ECE 201C	ara@email.arizona.edu
Sáez, A. Eduardo	Professor	621-5369	JWH 142C	esaez@email.arizona.edu
Shadman, Farhang	Professor	621-6052	JWH 134	shadman@erc.arizona.edu
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Sorooshian Armin	Assoc. Professor	626-6769	JWH 108E	armin@email.arizona.edu

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	TITLE	PHONE	OFFICE	EMAIL
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Ogden, Greg	Research Assoc. Professor	621-4422	JWH 105E	gogden@email.arizona.edu

STAFF

	TITLE	PHONE	OFFICE	EMAIL
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Foley, Alicia	Business Manager	626-8358	JWH 134	ali@erc.arizona.edu
Montaño, Norma	Business Manager	621-1910	JWH 141	nmontano@email.arizona.edu
Rodriguez, Ana	Manager, Finance, and Admin.	621-2415	JWH 141	rodrigua@email.arizona.edu
Wik, Michelle	Program Coordinator	621-1897	JWH 105C	michelles@email.arizona.edu

A2. Graduate Study Committees

CHEMICAL ENGINEERING

Armin Sorooshian, Chair and Director of Graduate Studies

Roberto Guzman

Dominic Gervasio

ENVIRONMENTAL ENGINEERING

Reyes Sierra, Chair and Director of Graduate Studies

Jim Farrell

Robert Arnold