CHEMICAL ENGINEERING, PH.D.

The doctoral program in chemical engineering provides students with advanced education and training in a variety of technical topics, including biotechnology, environmental technologies, high-performance computing and simulations, electrochemical systems, renewable energy and storage, and clean water. Students work closely with faculty to perform hands-on research, develop original research articles and intellectual property, and make scientific presentations at national and international conferences. Students from this program will be prepared to enter a variety of careers, such as higher education, entrepreneurship, consulting, and industrial and government research.

Admissions

Admission is contingent upon recommendation by the graduate faculty of the Department of Chemical and Biological Engineering. Admission opportunities are available for students with undergraduate degrees in fields other than chemical engineering (e.g., chemistry, biomedical engineering, and other related fields).

See the Admission Criteria section of this catalog for more information.

Curricular Requirements

The minimum coursework for the Ph.D. degree is 60 hours, which includes 42 hours of coursework and 18 hours of dissertation research. An overview of the curriculum is shown in the curricular table below, followed by a summary of the mandatory course requirements (core courses and seminar) and options for electives.

Curriculum Overview		Hours
Core Courses		
CHE 551	Adv Thermodynamics I	3
CHE 552	Transport Phenomena	3
CHE 554	Chemical Reaction Engr	3
Mathematics Core Elective		**3**
CHE 591	Special Problems (Mentored Grading Experience)	3
CHE 570	Chemical and Biological Engineering Research Techniques	1
Electives		**24**
Seminar Courses		**2**
Dissertation Research		**18**
Total Hours		**60**

Core Course Requirements

The department requires four "core" graduate courses, plus two seminar courses. The core courses must be taken at UA, unless the equivalent course credit is transferred from another domestic institution (with a grade of A- or higher). The four core courses are comprised of the three required CHE courses, plus one mathematical elective course, as well as the seminar requirement.

Electives

24 Hours of electives may be any of the following:

Code and Title		Hours
CHE 512	Polymer Materials Engineering	3
CHE 514	Computer Methods in ChemE	3
CHE 516	Stem Cell Bioengineering	3
CHE 518	Tissue Engineering	3
CHE 540	Health Safety Chem Process Ind	3
CHE 545	Introduction to Biochemical Engineering	3
CHE 591	Special Problems	3
CHE 592	Special Problems (Newly Developed Elective Courses)	3
CHE 595	Seminar	1
CHE 598	Non-Thesis Research	6
CHE 695	Seminar	1
CHE 698	Non-Dissertation Research	6
Total Hours		**38**

Mathematics Core Elective

Three hours may be any of the following:

Mathematical Core Course Elective Options		Hours
CHE 553	Computation In Chem Engr	3
GES 500	Engineering Statistics	3
GES 554	Partial Diff Equations	3
ST 560	Statistical Methods	3
MATH 509	Data Analysis: Sec Teachers	3
MATH 510	Numerical Linear Algebra	3
MATH 541	Boundary Value Problems	3
MATH 551	Math Stats W/Applictn I	3
CHE 514	Computer Methods in ChemE	3

Graduate Seminar Requirements

The department requires that students take and pass the Graduate Seminars: CHE 595 seminar during the first part of the doctoral program of study (normally during the second semester of enrollment) and CHE 695 Seminar in the latter part of the program (normally during the final semester of enrollment). These two hours of seminars count towards the coursework hours needed for graduation.

Seminar Course Requirement		Hours
CHE 595	Seminar	1
CHE 695	Seminar	1

Transfer Credit

Graduate School information on Transfer Credit.

Doctoral Plan of Study Requirement

Graduate School information on the Doctoral Plan of Study.

Comprehensive Exams

Doctoral Qualifier Exam

Once a student has completed all of the four core required graduate courses, the student is expected to take the doctoral qualifier ("qualifier") exam as a first evaluation stage in the doctoral program. This qualifier exam is offered twice per year, immediately following the end of the

spring semester (during the month of May) and immediately following the end of the fall semester (Dec/Jan).

The nature of the qualifier exam is an assignment to independently write (and defend in front of a faculty committee) a research proposal in a field related to (but not directly overlapping) the student's dissertation topic. The faculty committee will be composed of the major advisor plus two other departmental faculty members. The proposal topic and the committee composition will be the responsibility of the student/advisor to determine. The student will provide a written copy of the proposal to the committee, and the student will defend the proposal in front of the committee during an oral presentation. The student will typically be given 2-3 weeks to complete the assignment. There are three different possible outcomes from the qualifier exam:

a) Pass – Students take a "bypass" Plan II MS degree (after completing 30 hours) and continue in the doctoral program.

b) Conditional - Students perform extra work based on the deficiencies identified by the committee. After reevaluation (within 2-3 months) by the committee, the student will pass or fail. No other extensions or reevaluations will be provided.

c) Fail - The student may not continue as a doctoral student. The student is expected to work with the advisor to make a plan to finish any ongoing projects. Financial support beyond this point should not be expected by the student.

Ph.D. candidacy exam

The Ph.D. candidacy exam will be given (1) roughly a year after passing the Ph.D. qualifier exam and (2) after completing at least 30 hours of coursework (including transfer credits). The student will deliver a 30 minute presentation to his/her dissertation committee to provide an update on research progress, along with a summary of completed course work, presentations, publications, etc. There is no written component of the exam. A detailed research plan for future work must also be included.

- A pass/fail grade will be given. A student who fails the candidacy exam will be provided with written feedback on areas for improvement, and the student will have only one additional attempt to pass, which must be attempted during the following semester. A student that ultimately does not pass the exam will not be able to continue in the Ph.D. program, but the student will still have the option to complete an M.S. degree if desired.

Preliminary Defense Exam

The preliminary defense ("prelim") exam should be take after two full years of graduate study are completed, but at least nine months before degree completion. The exact date should be coordinated between a student and his/her Ph.D. advisor. The prelim exam is a formal presentation to the dissertation committee that provides a summary of progress to date (research accomplishments, scholarly publications, conference presentations, etc.). The exam consists of a written document (normally 15-20 pages in length, plus references), as well as a presentation (normally 30-45 minutes in duration, followed by a period of questions from the committee). Representative examples of the prelim exam (format, expectations, etc.) can be obtained from the Graduate Program Director upon request. A copy of the written document must be provided to the committee a minimum of two weeks before the scheduled prelim exam. There are three different possible outcomes from the prelim exam:

a) Pass – Students continue in the doctoral program and continue their research and dissertation progress.

b) Conditional - Students perform extra work based on the deficiencies identified by the committee. After reevaluation (within 2-3 months) by the committee, the student will pass or fail. No other extensions or reevaluations will be provided.

c) Fail - The student may not continue as a doctoral student. The student is expected to work with the advisor to make a plan to finish any ongoing projects. Financial support beyond this point should not be expected by the student.

Continuous Enrollment Policy

Graduate School information on Continuous Enrollment Policy.

Dissertation Requirements

Dissertation Committee Formation

Students should identify their committee and immediately after completing their qualifier exam. Since this exam is normally taken after the second semester in the program, the dissertation committee formation should be completed no later than the end of the third semester.

Dissertation Format

Dissertation format and submission procedures should follow Graduate School policies.

Time Limits for Degree Completion Requirements

Graduate School information on Time Limits.

Student Progress Requirement

Once the doctoral qualifier (comprehensive) exam is passed, doctoral students are required to schedule an annual update and review with their dissertation committee. It is the *student's responsibility* to schedule and coordinate this review. It should be a formal presentation lasting approximately 20-30 minutes (a written document is not required). If a candidacy exam or preliminary dissertation (prelim) exam is scheduled to occur within the same timeframe as the annual report, these exams can serve as a surrogate for the annual report. However, no more than 12 months should transpire between meetings that a student has with his/her dissertation committee. Satisfactory progress, as judged by the dissertation committee is required for continued participation in the doctoral program. In certain cases, the committee will provide a probationary period with specific deliverables/outcomes identified, in order for the student to continue in the doctoral program.

Academic Misconduct Information

Graduate School information on Academic Misconduct.

Withdrawals and Leave of Absence Information

Graduate School information on Withdrawals and Leave of Absence.

Academic Grievances Information

Graduate School information on Academic Grievances.

Grades and Academic Standing

Graduate School information on Grades and Academic Standing.

Graduate School Deadlines Information

Graduate School information on Graduate School Deadlines.

Application for Graduation Information

Graduate School information on the Application for Graduation.

Financial Support

Normally, only Ph.D. students are considered for fellowships or other forms of financial support within the Department of Chemical and Biological Engineering. Financial support for graduate students may include teaching assistantships, research assistantships, scholarships, or combinations of these sources. Once a student is admitted into the Ph.D. program, the stipend level is specified, but the source of the financial support may vary during the course of study. By default, stipends for Master's students are not provided, so the stipend amount is not specified. As the source of student support may vary from semester-to-semester, the obligations of the student may also vary. These obligations will normally be communicated to the student at the beginning of the semester, but there may be some variance over the course of the semester.

Continuation of Financial Support

If the faculty advisor judges that the student's research or academic performance is insufficient during a given semester, the faculty member will provide a written warning that funding may be terminated at the end of the semester. If the student is unable to improve performance by the end of the semester, the faculty member (after approval from the Department Head confirming that adequate warning was provided to the student) may terminate the student's funding. If a faculty advisor terminates funding for a graduate student, there is no obligation from the department to provide any additional funding to the student. Alternately, if a student is not able to pass one of his/her mandatory exams (Ph.D. Qualifier Exam, Annual Review, Candidacy Exam, or Preliminary Exam), the faculty advisor and/or department are under no obligation to continue funding the student in any future semester. If the GPA of a student in a single semester falls below a 3.0, the advisor and/or department are under no obligation to continue funding the student in any future semester. In unusual circumstances, the financial support of a student may be terminated before the end of the semester, but this will only occur if the faculty advisor, Department Head, and Dean of Engineering support this decision.