

# PH.D. IN ENGINEERING (CHEMICAL ENGINEERING)

## OVERVIEW

Our chemical engineering Ph.D. students perform cutting-edge research that aims to tackle the world's greatest energy, environmental and medical challenges. Current projects range from the production of renewable biofuels and polymers, to water purification, to development of nanomaterials for CO<sub>2</sub> capture, advanced catalysis, and sensing, to hydrogels for regenerative medicine. Our graduate students receive training in state-of-the-art experimental and modeling tools to prepare them for scientific leadership roles in industry, government and academia. Most graduates elect to pursue careers in industry, joining diverse companies throughout the United States. Others go on to prestigious faculty positions at research and teaching universities or pursue rewarding careers at other nonprofit and government institutions.

## ADMISSIONS REQUIREMENTS

Admission for graduate studies at The University of Toledo requires a four-year bachelor's degree from an accredited college or university. For all applicants from an accredited U.S. or Canadian university with an undergraduate GPA below 2.7 and for all international applicants from non-English speaking countries, GRE scores must be submitted with a quantitative GRE score of at least 155. For all international applicants from non-English speaking countries, a minimum TOEFL speaking score of 22 (or a minimum IELTS speaking score of 6.5). International students must also demonstrate adequate financial resources for their graduate education before admission.

Application requirements:

- **Degree:** Applicants must hold a four-year bachelor's degree from a regionally accredited college or university
- **GPA:** Applicants must have at least a 3.0/4.0 grade point average from previous undergraduate coursework or a 3.3/4.0 for previous graduate coursework
- **Application:** UToledo application required
- **GRE:** Required for applicants whose degree is from a non-US institution.
- **Transcripts:** Required
- **Statement of Purpose:** Required
- **Letters of Recommendation:** 3
- **Proof of English language proficiency:** Required for students from non-English speaking countries. See University graduate admissions for minimum test score requirements and exceptions.

Application priority deadlines for admissions and funding decisions:

- **Fall:** Contact Program
- **Spring:** Contact Program
- **Summer:** Contact Program

## PROGRAM REQUIREMENTS

The doctoral degree requires a total of 90 credit hours split equally between course work and dissertation research. However, to be formally admitted to candidacy for the degree, doctoral students must first pass the preliminary and qualifying examinations. After admission to candidacy, the completion of 45 credit hours of course work and 45 credit hours of dissertation research, doctoral candidates must prepare a written dissertation documenting their research efforts. Final approval for graduation is contingent upon a successful oral defense of the dissertation before the dissertation committee in a public forum.

The minimum requirements for the Doctor of Philosophy (Ph.D.) in Engineering are:

Code	Title	Hours
GNEN 5000	Graduate Launch	0
CHEE 8500	Advanced Chemical Reaction Engineering	3
CHEE 8510	Advanced Chemical Engineering Thermodynamics	3
CHEE 8550	Transport Phenomena I	3
CHEE 8560	Transport Phenomena II	3
Additional graduate course work, including:		33
CHEE 5930	Seminars in Chemical Engineering <sup>1</sup>	
Passage of the preliminary exam		
Passage of the qualifying exam		
Dissertation research (Completed to the satisfaction of the dissertation committee)		45
<b>Total Hours</b>		<b>90</b>

<sup>1</sup> All full-time students must register for one hour of CHEE 5930 each semester during the academic year. This course is graded on a satisfactory/unsatisfactory basis. To receive a grade of S, students must attend all seminars or provide a written explanation for their absence

Only credit hours obtained with a letter grade of C or higher, or an S grade for the limited number of classes offered on a satisfactory or unsatisfactory basis will fulfill degree requirements. Students must maintain a grade point average (GPA) of 3.0 or above.

For students admitted with a Bachelor's degree, the graduate course work must satisfy the following restrictions:

- No more than thirty (30) hours of Graduate Seminar (CHEE 5930), independent study, special problems or special topics
- No more than eleven (11) hours in 5000 level courses
- All courses must be taken at the 5000, 7000 or 8000 level in the College of Engineering, the College of Pharmacy, the College of Medicine and Life Sciences, or the Biology, Chemistry, Mathematics, Environmental Sciences, and Physics Departments of the College of Natural Sciences and Mathematics

The faculty may award students admitted with a Master in Chemical Engineering up to 30 hours of credit toward the Ph.D. This may include credit for core classes if the faculty deem classes taken as a Master student are comparable to the core classes. The student must satisfy all other requirements as listed above. Additional course work must satisfy the following restrictions:

- No more than fifteen (15) hours of Graduate Seminar (CHEE 5930), independent study, special problems or special topics.
- No more than four (4) hours in 5000 level courses
- All courses must be taken at the 5000 level or higher in the College of Engineering, the College of Pharmacy, or the Biology, Chemistry, Mathematics, Environmental Sciences, and Physics Departments of the College of Natural Sciences and Mathematics

## Preliminary Examinations

The purpose of the preliminary exam is to evaluate whether a student possesses the background necessary to complete doctoral degree requirements. The oral exam is given at the end of the first year for all new doctoral students.

The exam will require the students to formulate and defend a research plan, wherein they will: (1) propose a study (on a topic selected by the student and approved by the advisor) that can result in a peer-reviewed journal publication; (2) submit a 6 – 10 page double-spaced proposal; and (3) deliver a 15 – 20 minute presentation followed by questions. The advisor's role in the proposal and presentation preparation will be limited to approving the proposal topic (i.e., the advisor will not edit or provide feedback on the proposal before its submission/presentation to the faculty). To pass this exam, the candidate must demonstrate the ability to plan a study using appropriate research tools, be able to use chemical engineering principles to defend their research proposal, and exhibit effective written and oral communication skills.

Students either pass or fail the exam. The faculty as a whole will evaluate the results and will consider input from the student's advisor, TA assignment supervisors and classroom instructors to determine the final grade. Students who fail the exam may petition the Department to consider offering a retake of the exam. If permission is not granted, then the exam failure will be final.

Students that enter with a B.S. and ultimately fail the exam are required to complete a Master's degree or leave the program. Students that enter with a M.S. are required to leave the program or pursue another M.S. degree.

## Qualifying Exam

The qualifying exam consists of an oral defense of the proposed doctoral research project. The exam must be taken within one calendar year of passage of the preliminary exam. However, a student may petition the Department for extension of this time limit.

The student must submit a written proposal to their dissertation committee at least two weeks prior to the proposed exam date. The proposal should contain the following sections:

- a. Project Summary
- b. Research Objectives

- c. Research Significance
- d. Literature Review
- e. Research Plan
- f. Bibliography
- g. Budget

The entire proposal should be prepared using a 12 point font and one inch margins around the page. The project summary should be double spaced and extend not more than one page. Sections 2-5 should also be double spaced and not exceed 20 pages in length. The budget should indicate both monetary and time requirements.

There are no restrictions on the student concerning preparation of the proposal. Students may consult with both faculty and other students, if agreeable.

The oral defense consists of a brief presentation of the proposal, typically 30-45 minutes, followed by a question and answer session. During the exam, the committee will assess the appropriateness of the proposed project for a doctoral dissertation and the student's ability to successfully complete it; passage indicates that the committee believes the project is suitable and the student can complete it.

If a student fails the exam, they may petition the Department to retake the exam the following term. If permission is not granted, then the exam failure will be final.

Students that enter with a B.S. and ultimately fail the exam are required to complete a Master's degree or leave the program. Students that enter with a M.S. are required to leave the program or pursue another M.S. degree.

## Dissertation Defense

After completing all other degree requirements and preparing a final draft of the dissertation, the student may schedule a final defense date with the dissertation committee. The Graduate School provides guidelines for dissertation preparation.

The defense is open to all faculty members of the University. Consequently, the student must submit the defense date to the Graduate School two weeks in advance to permit University-wide notification. At the same time, each committee member should receive a copy of the dissertation draft.

The defense consists of a short oral presentation, 30-45 minutes in length, followed by a question and answer session. During the defense, the committee will evaluate if the student has satisfactorily completed the proposed dissertation research and possesses a Doctoral level understanding of general Chemical Engineering and the particular research area.

If more than one member of the Advisory Committee votes against accepting the dissertation, the student fails the defense. The student may revise the thesis to address the concerns of the committee and request reconsideration. If the student fails upon revision of the dissertation, the student will be dismissed from the program without award of the degree.

- PLO 1. an ability to conduct independent research
- PLO 2. an ability to communicate technical issues to others

- PLO 3. an ability to apply knowledge of mathematics, science, and engineering to problem solving
- PLO 4. an ability to identify, formulate and solve engineering problems
- PLO 5. an understanding of ethical conduct in engineering research