

# M.S. IN CHEMICAL ENGINEERING

## OVERVIEW

Our chemical engineering M.S. students grow their knowledge through rigorous coursework and 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. Through their coursework and research, our M.S. students receive training in state-of-the-art experimental and modeling tools to prepare them for leadership roles in industry and government, or further academic study. Most graduates elect to pursue careers in industry, joining diverse companies throughout the United States. Others go on to rewarding careers at nonprofit and government institutions, or continue their studies toward Ph.D. degrees.

## 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.

## Admission of Chemistry Majors

A special program is in place for students who are Chemistry Majors, and it requires them to take required pre-requisite courses. The plan assumes that two years of undergraduate calculus and one semester of physical chemistry have been completed. The student should contact the Graduate Director.

## PROGRAM REQUIREMENTS

Students may select one of three Master of Science in Chemical Engineering (M.S. Ch.E.) degree programs: (1) thesis, (2) non-thesis coursework, or (3) non-thesis project options. A Professional Science Master's Track in Green Chemistry and Engineering also is offered.

The thesis Master of Science in Chemical Engineering (M.S. Ch.E.) degree program requires completion of 30 hours of course credit, successful defense of a thesis and typically takes two years to complete. Minimum requirements are:

Code	Title	Hours
GNE5 5000	Graduate Launch	0
CHEE 6500	Advanced Chemical Reaction Engineering	3
CHEE 6510	Advanced Chemical Engineering Thermodynamics	3
CHEE 6550	Transport Phenomena I	3
CHEE 6560	Transport Phenomena II	3

Graduate course work	9
Continuous registration and attendance for the Graduate Seminar for full time students	
Thesis work completed to the satisfaction of the thesis committee and successful oral defense of the thesis before the committee in a public forum.	9
<b>Total Hours</b>	<b>30</b>

The non-thesis Master of Science options are: course work and project. For the coursework option, students are required to complete 30 credit hours of approved graduate study including:

Code	Title	Hours
CHEE 6500	Advanced Chemical Reaction Engineering	3
CHEE 6510	Advanced Chemical Engineering Thermodynamics	3
CHEE 6550	Transport Phenomena I	3
CHEE 6560	Transport Phenomena II	3
Graduate course work		18
<b>Total Hours</b>		<b>30</b>

For the project option, students are required to complete 30 credit hours of approved graduate study, including six hours of a Master of Science project as specified. Students are required to submit a written project report to the department after approval by the chemical engineering faculty project supervisor. Specific requirements are:

Code	Title	Hours
CHEE 6500	Advanced Chemical Reaction Engineering	3
CHEE 6510	Advanced Chemical Engineering Thermodynamics	3
CHEE 6550	Transport Phenomena I	3
CHEE 6560	Transport Phenomena II	3
Graduate course work		12
CHEE 6920	Chemical Engineering Project (completed to the satisfaction of the faculty project supervisor)	6

Continuous registration and attendance for the Graduate Seminar for full time students

<b>Total Hours</b>	<b>30</b>
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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. Additionally, the graduate course work must satisfy the following restrictions:

- No more than six (6) hours of Graduate Seminar (CHEE 5930), independent study, special problems, or special topics
- No more than seven (7) hours in dual level courses; courses with a minority enrollment of selected undergraduates are not restricted
- All courses must be taken at the 5000 level or higher in the College of Engineering, the College of Pharmacy and Pharmaceutical Sciences, the College of Medicine and Life Sciences, or the College of Natural Sciences and Mathematics.

Students should carefully select their courses to enhance their educational background and complement their research activities. Additionally, all students must register for one hour of Seminars in

Chemical Engineering, 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.

The Professional Science Masters option requires completion of 30 hours of coursework, 6 hours of industrial internship, and typically takes one year to complete. Minimum requirements are:

Code	Title	Hours
CHEM 6200	Green Chemistry	3
CHEM 6210	Environmental Chemistry	3
CHEE 6010	Green Engineering Principles	3
CHEE 6110	Green Engineering Applications	3
BUAD 6600	Supply Chain Management	3
EFSB 6690	Strategic Management of Innovation	3
or EFSB 6590	New Venture Creation	
Elective graduate course work		12
CHEE 6970	Graduate Engineering Internship	6
<b>Total Hours</b>		<b>36</b>

Students possessing a Bachelor's degree in Chemical Engineering are required to take three additional hours of elective graduate course work in lieu of CHEE 6010.

The elective graduate course work may come from traditional areas of chemistry and chemical engineering at the 6000 level. Up to four hours of 6000 level course work in a related discipline (e.g., environmental sciences or physics) and up to two hours of independent research project (CHEE 6980) may be applied to the elective graduate course work requirement subject to the approval of the PSM program director. Research seminar (CHEE 5930) cannot be applied towards the elective graduate course work.

Six (6) hours of Graduate Engineering Internship (CHEE 6970) also are required. The Graduate Industrial Internship must be completed at an industry, governmental organization, or non-governmental organization in an area relevant to green chemistry and engineering. The PSM program director will assist in identifying Internship opportunities and must approve all placements. Students who are working or have worked part or full-time in a relevant job may request Internship credit for this work experience. The Director will evaluate all such requests and give credit if appropriate.

## Admission of Chemistry Majors

A special program is in place for students who are Chemistry Majors, and it requires them to take required prerequisite courses. The plan assumes that two years of undergraduate calculus and one semester of physical chemistry have been completed. The student should contact the Graduate Director.

Our student learning outcomes (SLOs) are to graduate students who will have:

1. an ability to conduct research or complete engineering projects
2. an ability to communicate technical issues to others
3. an ability to apply knowledge of mathematics, science, and engineering to problem solving

4. an ability to identify, formulate and solve engineering problems
5. an understanding of ethical conduct in engineering research and/or practice.