

# BACHELOR OF ENGINEERING IN CHEMICAL ENGINEERING, 4+ 1 GRADUATE TRACK

## Introduction

The Chemical Engineering Program at Youngstown State University—supplemented with courses in chemistry, physics, mathematics, and general engineering—provides a broad preparation for design, operation, and management in the chemical, biomedical, biological, nuclear, pharmaceutical, and energy-conversion industries, as well as graduate study leading to research positions in industry and government and to academic careers.

## Program Contact Information

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## Educational Objectives

Graduates of the chemical engineering program at YSU:

- Pursue careers as practicing chemical engineers in chemical and energy-related industries as well as in areas of materials, environmental, and biomedical engineering and biotechnology.
- Demonstrate strong, functional command of chemical engineering fundamentals and hold safety as paramount in the operation and design of chemical processes.
- Are aware of the scope of the chemical engineering profession and its global opportunities and requirements.
- Exhibit professional responsibility and a sensitivity to a broad range of societal concerns including ethical, environmental, political, regulatory, and global issues in making decisions.

## Mission

The mission of the Chemical Engineering program is to:

1. Offer a wide variety of electives to students according to the global trend in chemical engineering
2. Provide real world experiences to students through laboratory study and capstone experiences
3. Conduct research with faculty in the areas commonly associated with traditional chemical engineering disciplines and their impact on the local and global environment
4. Participate in interdisciplinary programs.

## Admission into the Program

To be admitted into the program, students are required to have an overall GPA of 2.3 and a grade of "C" or higher in CHEM 1515/L, MATH 1571, and ENGL 1550. Students can only repeat these courses one time.

## Graduation Policy

In addition to the overall recalculated "C" average required by the University, an unrecalculated "C" average in the major is required. Also, an unrecalculated "C" average in all engineering courses is required.

## Student Outcomes

The curriculum is structured to achieve the following outcomes as prescribed by ABET:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

## Accreditation

The Chemical Engineering BE program has been accredited by Engineering Accreditation Commission of ABET, <https://www.abet.org> (<https://www.abet.org/>), under the commission's General Criteria and Program Criteria for Chemical, Biochemical, Biomolecular and Similarly Named Engineering Programs.

## Co-Operative Education and Internships

The Chemical Engineering Program encourages all of its students to participate in co-ops and internships prior to graduation. Students should register with the STEM Office of Professional Practice in order to participate.

## Facilities

The chemical engineering laboratories are well-equipped for undergraduate instruction and student and faculty research. The equipment includes fluid flow apparatus, concentric tube and plate and frame heat exchangers, thermal conductivity apparatus, boiling heat transfer apparatus, tray dryer, double effect evaporator, computer-controlled distillation tower, gas absorption and liquid-liquid extraction columns, chemical reactors, electrostatic particle separator, centrifuges, filter presses, and other miscellaneous equipment.

For more information, contact Holly J. Martin, Program Coordinator.

COURSE	TITLE	S.H.
<b>FIRST YEAR REQUIREMENT -STUDENT SUCCESS</b>		
YSU 1500	Success Seminar	1-2
or YSU 1500S	Youngstown State University Success Seminar	
or HONR 1500	Intro to Honors	
<b>General Education Requirements</b>		
ENGL 1550	Writing 1	3-4
or ENGL 1549	Writing 1 with Support	
ENGL 1551	Writing 2	3
Mathematics requirement (met with MATH in major)		
Select one Arts and Humanities:		
PHIL 1561	Technology and Human Values	3

PHIL 2625	Introduction to Professional Ethics		CHEM 1515L	General Chemistry 1 Laboratory	1	
PHIL 2626	Engineering Ethics		CHEM 1516	General Chemistry 2	3	
PHIL 2628	Business Ethics		CHEM 1516L	General Chemistry 2 Laboratory	1	
Natural Science (met with CHEM and PHYS required for major)			CHEM 3719	Organic Chemistry 1	3	
Arts and Humanities (1 course)			3	CHEM 3719L	Organic Chemistry 1 Laboratory	1
Social Sciences (2 courses)			6	CHEM 3719R	Organic Chemistry Recitation 1	1
Required General Education Elective			3	CHEM 3720	Organic Chemistry 2	3
CMST 1545	Communication Foundations		CHEM 3720L	Organic Chemistry 2 Laboratory	1	
General Education Electives (6 s.h. Select 2 courses)			6	CHEM 3720R	Organic Chemistry Recitation 2	1
<b>General Engineering Courses</b>				CHEM 3739	Physical Chemistry 1	3
ENGR 1500	Engineering Orientation	1	<b>Physics Courses</b>			
ENGR 1550	Engineering Concepts	2	PHYS 2610	General Physics 1	4	
ENGR 1560	Engineering Computing	2	PHYS 2611	General Physics 2	4	
<b>Chemical Engineering Courses</b>			<b>Regulatory Safety (choose one of the following)</b>			
CHEN 2650	Computer Methods in Chemical Engineering	2	CHEN 4860	Chemical Engineering Process Safety Management	2-3	
CHEN 2683	Chemical Engineering Principles 1	3	ENST 5810	Environmental Safety		
CHEN 2684	Chemical Engineering Principles 2	3	ENST 5860	Environmental Regulations		
CHEN 3771	Chemical Engineering Thermodynamics 1	3	<b>Total Semester Hours</b>			
CHEN 5800A	Special Topics Thermo Dynamics Lab	1	<b>128-131</b>			
CHEN 3785L	Transport Phenomena Laboratory	1	<b>Dual Credit Requirements</b>			
CHEN 3786	Transport Phenomena 1	4	<b>Accelerated 4+1 Program</b>			
CHEN 3787	Transport Phenomena 2/Unit Operations 1	3	Undergraduate Chemical Engineering students can apply for admission into the accelerated 4+1 MSE in Chemical Engineering graduate program after completing 78 undergraduate semester hours with a GPA of 3.3 or higher. After being admitted to the accelerated 4+1 MSE program, students will be allowed a maximum of nine semester hours of graduate coursework, specified as 5000 level or higher, to be double counted toward both a bachelor's and master's degrees. The courses chosen to count for both undergraduate and graduate coursework must be approved by the Graduate Program Director. An additional three hours of graduate coursework can be completed as an undergraduate and used exclusively for graduate credit. This allows the student to graduate with a master's degree with one year of additional full-time study beyond the bachelor's degree, as the total hours counted towards the Master's degree is greater than or equal to 30 hours.			
CHEN 3787L	Unit Operations Laboratory 1	1	<b>Courses Counting Towards Requirements</b>			
CHEN 4815	Unit Operations 2	3	<b>COURSE</b>	<b>TITLE</b>	<b>S.H.</b>	
CHEN 4815R	Unit Operations 2 Applications	1	Select 3 of these courses, as only 3 can be double counted. Can select a 4th that would only count for the Master's degree.			
CHEN 4815L	Unit Operations Laboratory 2	1	CHEN 5800D	Spec Topics Adv Thermodynamics	3	
CHEN 4880	Chemical Reactor Design 1	3	CHEN 5800E	Special Topics Chemical Safety Process	3	
CHEN 4880R	Reactor Design Applications	1	CHEN 5800I	Special Topics Green Engineering	3	
CHEN 4882	Process Dynamics	3	CHEN 5800J	Special Topics Materials Engineering	3	
CHEN 4887	Process and Plant Design 1	3	CHEN 5800M	Special Topics Advanced Chemical Engineering Thermodynamics	3	
CHEN 4888	Process and Plant Design 2	3	CHEN 5805	Principles of Biomedical Engineering	3	
Chemical Engineering Electives (select two courses from the following)			6	CHEN 5811	Advanced Transport Phenomena	3
STEM 4890	STEM Internship		CHEN 5820	Industrial Pollution Control	3	
CHEN 2688	Energy Assessment		CHEN 5821	Fundamentals of Polymer Science	3	
CHEN 3700	Measurements and Instrumentation		CHEN 5845	Corrosion Engineering	3	
CHEN 4801	Chemical Engineering Projects		CHEN 5883	Mathematical Methods in Chemical Engineering	3	
CHEN 4840	Biochemical Engineering Fundamentals		CHEN 6981	Advanced Chemical Reaction Engineering	3	
CHEN 5800	Special Topics		<b>Mathematics/Statistics Courses</b>			
CHEN 5800I	Special Topics Green Engineering		MATH 1571	Calculus 1	4	
CHEN 5805	Principles of Biomedical Engineering		MATH 1572	Calculus 2	4	
CHEN 5811	Advanced Transport Phenomena		MATH 2673	Calculus 3	4	
CHEN 5820	Industrial Pollution Control		Accelerated Honors Calculus 1 and 2 can be substituted for Calculus 1, 2, and 3			
CHEN 5821	Fundamentals of Polymer Science		MATH 3705	Differential Equations	3	
CHEN 5845	Corrosion Engineering		STAT 3743	Probability and Statistics	4	
CHEN 5850	Industrial Processes		<b>Chemistry Courses</b>			
CHEN 5883	Mathematical Methods in Chemical Engineering		CHEM 1515	General Chemistry 1	3	
CHEN 6981	Advanced Chemical Reaction Engineering		<b>Year 1</b>			
<b>Mathematics/Statistics Courses</b>			<b>Fall</b>			
MATH 1571	Calculus 1	4	YSU 1500	Success Seminar	1-2	
MATH 1572	Calculus 2	4	or YSU 1500S	or Youngstown State University Success Seminar		
MATH 2673	Calculus 3	4	or HONR 1500	or Intro to Honors		
Accelerated Honors Calculus 1 and 2 can be substituted for Calculus 1, 2, and 3						
MATH 3705	Differential Equations	3				
STAT 3743	Probability and Statistics	4				
<b>Chemistry Courses</b>						
CHEM 1515	General Chemistry 1	3				

ENGL 1550 or ENGL 1549	Writing 1 or Writing 1 with Support	3-4
ENGR 1500	Engineering Orientation	1
ENGR 1550	Engineering Concepts	2
CHEM 1515	General Chemistry 1	3
CHEM 1515L	General Chemistry 1 Laboratory	1
MATH 1571	Calculus 1	4
GER AH-1	Arts and Humanities Elective	3
<b>Semester Hours</b>		<b>18-20</b>
<b>Spring</b>		
ENGL 1551	Writing 2	3
ENGR 1560	Engineering Computing	2
GER GE-1 CMST 1545	Communication Foundations	3
CHEM 1516	General Chemistry 2	3
CHEM 1516L	General Chemistry 2 Laboratory	1
MATH 1572	Calculus 2	4
<b>Semester Hours</b>		<b>16</b>
<b>Year 2</b>		
<b>Fall</b>		
CHEM 3719	Organic Chemistry 1	3
CHEM 3719L	Organic Chemistry 1 Laboratory	1
CHEM 3719R	Organic Chemistry Recitation 1	1
MATH 2673	Calculus 3	4
PHYS 2610	General Physics 1	4
CHEM 2683	Chemical Engineering Principles 1	3
CHEM 2650	Computer Methods in Chemical Engineering	2
<b>Semester Hours</b>		<b>18</b>
<b>Spring</b>		
CHEM 3720	Organic Chemistry 2	3
CHEM 3720L	Organic Chemistry 2 Laboratory	1
CHEM 3720R	Organic Chemistry Recitation 2	1
MATH 3705	Differential Equations	3
PHYS 2611	General Physics 2	4
CHEM 2684	Chemical Engineering Principles 2	3
<b>Semester Hours</b>		<b>15</b>
<b>Year 3</b>		
<b>Fall</b>		
CHEM 3739	Physical Chemistry 1	3
STAT 3743	Probability and Statistics	4
CHEM 3771	Chemical Engineering Thermodynamics 1	3
CHEM 5800A	Special Topics Thermo Dynamics Lab	1
CHEM 3786	Transport Phenomena 1	4
<b>Semester Hours</b>		<b>15</b>
<b>Spring</b>		
GER SS-1	Social Science Elective	3
GER GE-2	General Education Elective	3
CHEM 3787	Transport Phenomena 2/Unit Operations 1	3
CHEM 4880	Chemical Reactor Design 1	3
Regulatory Safety Course <sup>3</sup>		2-3
CHEM 4880R	Reactor Design Applications	1
CHEM 3785L	Transport Phenomena Laboratory	1
<b>Semester Hours</b>		<b>16-17</b>
<b>Year 4</b>		
<b>Fall</b>		
GER AH-2	Arts and Humanities Elective: Ethics <sup>1</sup>	3
CHEM 3787L	Unit Operations Laboratory 1	1

CHEM 4815	Unit Operations 2	3
CHEM 4815R	Unit Operations 2 Applications	1
CHEM 4887	Process and Plant Design 1	3
CHEM Elective-1	Chemical Engineering Elective <sup>2</sup>	3
<b>Semester Hours</b>		<b>14</b>
<b>Spring</b>		
GER SS-2	Social Science Elective	3
GER GE-3	General Education Elective	3
CHEM 4815L	Unit Operations Laboratory 2	1
CHEM 4882	Process Dynamics	3
CHEM 4888	Process and Plant Design 2	3
CHEM Elective-2	Chemical Engineering Elective <sup>2</sup>	3
<b>Semester Hours</b>		<b>16</b>
<b>Total Semester Hours</b>		<b>128-131</b>

Note: Transfer students from any two- or four-year academic program at other institutions or at this University who wish to pursue studies in chemical engineering should consult with the program coordinator for individual counseling to develop a program of study that fully uses their educational background and requires a minimum of time to satisfy the requirements for the degree of Bachelor of Engineering in chemical engineering.

COURSE	TITLE	S.H.
<b>1. Ethics Elective</b>		
<b>3</b>		
Select one of the following:		
PHIL 1561	Technology and Human Values	
PHIL 2625	Introduction to Professional Ethics	
PHIL 2626	Engineering Ethics	
PHIL 2628	Business Ethics	
<b>2. Chemical Engineering Elective</b>		
<b>6</b>		
Select 2 courses from the following:		
Can select 3 from this list, over the 5000 level, to double count towards Bachelor's and Master's, after acceptance into the MSE program. Can select a 4th that counts only towards Master's Degree.		
STEM 4890	STEM Internship	
CHEM 2688	Energy Assessment	
CHEM 3700	Measurements and Instrumentation	
CHEM 4801	Chemical Engineering Projects	
CHEM 4840	Biochemical Engineering Fundamentals	
CHEM 5800	Special Topics	
CHEM 5800I	Special Topics Green Engineering	
CHEM 5805	Principles of Biomedical Engineering	
CHEM 5811	Advanced Transport Phenomena	
CHEM 5820	Industrial Pollution Control	
CHEM 5821	Fundamentals of Polymer Science	
CHEM 5845	Corrosion Engineering	
CHEM 5850	Industrial Processes	
CHEM 5883	Mathematical Methods in Chemical Engineering	
CHEM 6981	Advanced Chemical Reaction Engineering	
Other courses may be used at the discretion of the program coordinator		
<b>3. Regulatory Safety Course</b>		
Choose one of the following:		
CHEM 4860		2
ENST 5810	Environmental Safety	3
ENST 5860	Environmental Regulations	3
<b>Total Semester Hours</b>		<b>17</b>

**Student Outcomes**

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies