BACHELOR OF ENGINEERING IN CHEMICAL ENGINEERING

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.

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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 the Engineering Accreditation Commission of ABET, http://www.abet.org.

CHEMICAL ENGINEERING ANNUAL ENROLLMENT AND GRADUATION DATA

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Bachelor of Engineering</th>
<th>Fall Enrollment</th>
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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 Dr. Douglas M. Price, Program Coordinator.
Bachelor of Engineering in Chemical Engineering

<table>
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<tr>
<th>Year 2</th>
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<tbody>
<tr>
<td>CHEN 3719 &amp; 3719L</td>
<td>Organic Chemistry 1 and Organic Chemistry 1 Laboratory 4</td>
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<td>MATH 2673</td>
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<td>CHEN 2650</td>
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<td>GER SPA-1</td>
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<td>Arts and Humanities Elective: Ethics 1 3</td>
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<td>Unit Operations Laboratory 1 1</td>
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<td>CHEN 4887</td>
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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.

1. Ethics Elective 3
   - PHIL 1561 | Technology and Human Values 3 |
   - PHIL 2625 | Introduction to Professional Ethics |
   - PHIL 2626 | Engineering Ethics |
   - PHIL 2628 | Business Ethics |

2. Advanced Chemistry/Biology Elective 3
   - Select one course from the following: |
     - CHEN 4840 | Biochemical Engineering Fundamentals (can be used as CHEN elective but not counted in both categories) |
     - CHEN 5805 | Principles of Biomedical Engineering (can be used as CHEN elective but not counted in both categories) |
     - CHEN 5821 | Fundamentals of Polymer Science (can be used as CHEN elective but not counted in both categories) |
     - CHEN 5845 | Corrosion Engineering (can be used as CHEN elective but not counted in both categories) |

3. Engineering Elective 3
   - Other courses may be used at the discretion of program coordinator

4. Chemical Engineering Elective 6
   - Select 2 courses from the following: |
     - CHEN 2688 | Energy Assessment |
     - CHEN 4840 | Biochemical Engineering Fundamentals |
     - CHEN 3726 | Elementary Nuclear Reactor Engineering |
     - CHEN 4801 | Chemical Engineering Projects |
     - CHEN 5800 | Special Topics |
     - CHEN 5805 | Principles of Biomedical Engineering |
     - CHEN 5811 | Advanced Transport Phenomena |
     - CHEN 5820 | Industrial Pollution Control |
     - CHEN 5821 | Fundamentals of Polymer Science |
     - CHEN 5850 | Industrial Processes |
     - CHEN 5854 | Corrosion Engineering |
     - CHEN 5883 | Mathematical Methods in Chemical Engineering |
ENGR 1500 Engineering Orientation 1 s.h.
Introduction to engineering careers and the different engineering disciplines. Academic success strategies and university resources to support student success.
Prereq.: ENGR 1500, MATH 1551 or concurrent.

CHEM 3720 Advanced Chemical Reaction Engineering
Other courses may be used at the discretion of the program coordinator.

ENGR 1550 Engineering Concepts 2 s.h.
Introduction to the basic skills needed in engineering including engineering computing and an introduction to the engineering design process utilizing science, technology, engineering, and mathematics (STEM) fundamentals. One hour lecture and three hours laboratory per week.
Prereq.: Eligibility to take MATH 1513 or higher level math course.

ENGR 1560 Engineering Computing 2 s.h.
Computing skills required in engineering. Structured programming. Engineering problems and open ended design projects are solved in teams with results professionally presented. 1.5 hours lecture, 1.5 hours lab.
Prereq.: ENGR 1500, MATH 1517 or concurrent.

CHEM 3720L General Chemistry 1 Laboratory 0 s.h.
General Chemistry 1 Laboratory.

CHEM 1515 General Chemistry 1 4 s.h.
An introduction to the fundamental principles of chemistry, including measurement and calculation; chemical stoichiometry; the properties of gases; atomic and molecular structure; bonding; thermochemistry; and periodic properties. Intended for majors in the natural sciences and engineering. Three hours lecture, three hours lab-discussion.
Prereq.: CHEM 1501 or equivalent; MATH 1513 or equivalent.
Concurrent: CHEM 1515L; CHEM 1515R if major or repeating CHEM 1515.
Gen Ed: Natural Science.

CHEM 1515L General Chemistry 1 Laboratory 0 s.h.
General Chemistry 1 Laboratory.

CHEM 1516 General Chemistry 2 4 s.h.
A continuation of the study of the principles of chemistry, including solution properties; acids and bases; chemical equilibrium; thermodynamics; reaction kinetics; and electrochemistry. Intended for majors in the natural sciences and engineering. Three hours lecture, three hours lab-discussion.
Prereq.: "C" or better in CHEM 1515; Concurrent: CHEM 1516L; CHEM 1516R if major or repeating CHEM 1516.
Gen Ed: Natural Science.

CHEM 1516L General Chemistry 2 Laboratory 0 s.h.
General Chemistry 2 Laboratory.

CHEM 3719 Organic Chemistry 1 4 s.h.
Organic compounds, reactions and theories. Typical preparations and procedures of analysis. Three hours lecture, three hours lab-discussion.
Prereq.: "C" or better in CHEM 1516.

CHEM 3719L Organic Chemistry 1 Laboratory 0 s.h.
Organic Chemistry 1 Laboratory.

CHEM 3720 Organic Chemistry 2 4 s.h.
Organic compounds, reactions and theories. Typical preparations and procedures of analysis. Three hours lecture, three hours lab-discussion.
Prereq.: "C" or better in CHEM 3719.

CHEM 3720L Organic Chemistry 2 Laboratory 0 s.h.
Organic Chemistry 2 Laboratory.

CHEM 3739 Physical Chemistry 1 3 s.h.
Principles and applications of thermodynamics and kinetics to chemical systems.
Prereq.: "C" or better in CHEM 3720, PHYS 2611, PHYS 2611L, MATH 1572.

CHEM 4860 Regulatory Aspects of Industrial Chemistry 1 s.h.
Roles and responsibilities of industrial chemists. Industrial hygiene and safety. Industrial chemical processes, their waste products, their environmental effects, and the treatment of pollutants. Governmental regulations relating to waste disposal, product safety, occupational safety, resource conservation, environmental protection, and problems of awareness and compliance.
Prereq.: CHEM 3720.
CHEN 3785L  Transport Phenomena Laboratory  1 s.h.
Experimental studies of transport properties and momentum, energy and mass transfer using industrial type equipment. Correlation of data and comparison with theory. Oral presentations and preparation of technical reports. Three hours laboratory.
Prereq.: CHEN 3786 or concurrent.

CHEN 3787  Transport Phenomena 2/Unit Operations 1  3 s.h.
Mass transfer processes. Diffusional operations and separation processes with emphasis on evaporation, humidification and drying. Derivation of design equations from mass and energy balances, and application to equipment design. Solution of simultaneous differential equations of mass, momentum, and energy.
Prereq.: CHEN 3786.

CHEN 3787L  Unit Operations Laboratory 1  1 s.h.
Experiments in absorption, cascade operations, reaction kinetics, mixing and other chemical engineering operations employing industrial and pilot plant size equipment and instrumentation. Treatment of experimental data, correlations and comparison with theory. Oral presentations and preparation of technical reports. Three hour laboratory.
Prereq.: CHEN 3787.

CHEN 4815  Unit Operations 2  3 s.h.
Gas absorption and desorption, interphase mass transfer processes, liquid extraction and leaching. Physical separation processes including filtration, settling, and size reduction. Derivation of the design equations for the above processes, and applications of the design equations to equipment design.
Prereq.: CHEN 3787.

CHEN 4815L  Unit Operations Laboratory 2  1 s.h.
Experiments in absorption, cascade operations, reaction kinetics, mixing and other chemical engineering operations employing industrial and pilot plant size equipment and instrumentation. Treatment of experimental data, correlations and comparison with theory. Oral presentations and preparation of technical reports. Three hour laboratory.
Prereq.: CHEN 4815.

CHEN 4880  Chemical Reactor Design 1  3 s.h.
Chemical reaction equilibria. Theoretical developments and methods of interpreting experimental data pertaining to chemical kinetics. General design principles and construction features of reactors with application of these principles to the design of specific reactors.
Prereq.: CHEN 3771.

CHEN 4882  Process Dynamics  3 s.h.
Introduction to automatic control and control loop concepts. Laplace transform techniques. Linear open-loop and closed-loop systems. Root-locus and frequency response methods. Design of control systems.
Prereq.: CHEN 3786.

CHEN 4887  Process and Plant Design 1  3 s.h.
An examination of engineering economic analysis to include: cost estimation, profitability, optimum design, principles of fixed and operating costs, materials and site selection, and general and specialized design techniques.
Prereq.: CHEN 3787 and unrecalculated GPA of 2.0 or better in major courses.

CHEN 4888  Process and Plant Design 2  3 s.h.
The application of chemical engineering and cost principles to the component design and selection of process equipment. The application of chemical engineering and cost principles to the design of chemical plants and processes including societal aesthetic, environmental, and safety considerations.
Prereq.: CHEN 4887.

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.
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