Chemical, Biological, and Pharmaceutical Engineering

Chemical engineers use chemistry, biology, physics and math in an integrated engineering mode in order to manufacture materials and products to modern society. They are involved with the full scale of processes, from the laboratory bench to the pilot plant and eventually to the manufacturing facility. The academic training of chemical engineers provides a strong background for a variety of areas, including;

- Process Design
- Pharmaceutical Engineering
- Production Engineering
- Research and Development
- Marketing/Technical Sales
- Environmental and Waste Management
- Safety

At present, chemical engineers are involved in areas such as producing more effective pharmaceuticals and more durable plastics, developing, biotechnology, genetic engineering applications, and producing electronic materials. They are also involved in the more traditional areas of petroleum refining and chemical manufacturing. A Chemical engineer may choose to work in a variety of industries which include chemicals, pharmaceuticals, food, energy, and environmental control. A chemical engineering degree also serves as a good preparation for law, business, or medical school.

The Mission of the Department is to:

1. Educate undergraduate students for employment in industry and the pursuit of graduate studies;
2. Educate graduate students for employment in industry, government, or academe;
3. Educate students, both undergraduate and graduate, for leadership roles;
4. Engage in research to support the advanced education of graduate students, maintain the intellectual vitality of the faculty, and expand the frontiers of knowledge in areas of importance to the state and nation;
5. Publish and present the results of our intellectual activities, resulting from both research as well as teaching advances;
6. Serve our profession through membership and leadership on national and international societies, journals and editorial boards; and
7. Serve our wider constituencies by offering our expertise to industries, state and local communities, and pre-college students and teachers.

Chemical Engineering Program Education Objectives

Engineering Practice

Graduates of our program are successfully engaged in the practice of chemical engineering within industry, academe and government working in a wide array of technical specialties including but not limited to process and plant design operations.

Professional Growth

Graduates of our program advance their skills through professional growth and development activities such as graduate study in engineering or complimentary disciplines, and continuing education; some graduates will transition into other professional fields such as business, law and medicine through further education.

Service

Graduates of our program perform service to the society and the engineering profession through participation in professional societies, government, civic organizations, and humanitarian endeavors.

Chemical Engineering Program Outcomes

Graduates of the Otto H. York Department of Chemical, Biological and Pharmaceutical Engineering will have:

- an ability to apply knowledge of mathematics, science and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data of importance to the design and analysis of chemical processes.
- an ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- an ability to function on multi-disciplinary teams
- an ability to identify, formulate, and solve engineering problems

- an understanding of professional and ethical responsibility
- an ability to communicate effectively through written reports and oral presentations.
- the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context
- a recognition of the need for, and an ability to engage in life-long learning
- an introduction to contemporary issues in chemical engineering
- an ability to use the techniques, skills and modern engineering tools necessary for chemical engineering practice.

This program is accredited by the Engineering Accreditation Commission of ABET, http://abet.org.

Advisement

All students are required to see their advisor at least once each semester immediately prior to formal registration for the following semester(s). Registration holds are removed following the meeting. All undergraduates must schedule their appointments online using Map-Works, to see their undergraduate advisor, Gordana Obuskovic.

Freshman Advisement

Some freshmen are assigned courses (CHEM 121 Fundamentals of Chemical Principles I-CHEM 122 Fundamentals of Chemical Principles II; ENG 095 General Skills in English as a Second Language-HUM 099 English Composition: Reading, Writing, Speaking I-HUM 100 English Composition: Reading, Writing, Speaking II) and/or lightened credit loads. It is particularly important for these students to see their advisor to plan their courses for subsequent semesters. Completing pre-requisites for sophomore courses may involve attending summer sessions and/or spending an additional semester at NJIT.

NJIT Faculty

A

Armenante, Piero M., Distinguished Professor

B

Baltzis, Basil C., Professor

Barat, Robert B., Professor

Basuray, Sagnik, Assistant Professor

Bilgili, Ecevit A., Associate Professor

D

Dave, Rajesh N., Distinguished Professor

Dreyzin, Edward L., Distinguished Professor

G

Gogos, Costas, Distinguished Research Professor

Gor, Gennady, Assistant Professor

Guvendiren, Murat, Assistant Professor

H

Hanesian, Deran, Professor

Huang, Ching-Rong, Professor Emeritus

K

Khusid, Boris, Professor

Kimmel, Howard, Professor Emeritus

L

Loney, Norman, Professor

P

Perna, Angelo, Professor

Pfeffer, Robert, Distinguished Professor Emeritus

R

Rosty, Roberta, Senior University Lecturer

S

Schoenitz, Mirko, Associate Research Professor

Sebastian, Donald H., Professor

Simon, Laurent, Associate Professor

Sirkar, Kamalesh K., Distinguished Professor

T

Tomkins, Reginald P.T., Professor

V

Voronov, Roman S., Assistant Professor

W

Wang, Xianqin, Associate Professor

X

Xu, Xiaoyang, Assistant Professor

- Chemical Engineering - B.S. (http://catalog.njit.edu/undergraduate/newark-college-engineering/chemical-biological-pharmaceutical/bs)
- Chemistry Minor (http://catalog.njit.edu/undergraduate/newark-college-engineering/chemical-biological-pharmaceutical/chemistry-minor-chemical-engineering-majors) (for Chemical Engineering majors)

Chemical, Biological, and Pharmaceutical Engineering Courses

CHE 101. Introduction to Chemical Engineering. 0 credits, 1 contact hour (1;0;0).
Prerequisites: None. An introduction to the field of chemical engineering and to the Otto H. York Department of Chemical Engineering. Topics include the curriculum, tours of department teaching laboratories and computing facilities, undergraduate research opportunities, cooperative employment, and student professional societies. Also included are visits by alumni who discuss their careers after graduation from the department.

CHE 210. Chemical Process Calculations I. 2 credits, 3 contact hours (3;0;0).
Prerequisites: CHEM 126 or CHEM 122, MATH 112. Corequisite: CS 115. Analysis of chemical processes is introduced, emphasizing steady and unsteady-state mass and species balances. This course uses primarily chemistry and algebra to determine, for a wide variety of processes and applications, the flow and concentrations of different chemical species.

CHE 210W. Chemical Process Calculations I. 0 credits, 1 contact hour (1;0;0).
Workshop.

CHE 230. Chemical Engineering Thermodynamics I. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHEM 126, MATH 112, PHYS 111. Corequisite MATH 211 (or MATH 213). The Fundamentals of thermodynamics are applied to chemical engineering processes. Thermophysical properties and their engineering correlations are covered. Applications include chemical engineering and related fields such as environmental and biomedical engineering.

CHE 230W. Chemical Engineering Thermodynamics I Workshop. 0 credits, 1 contact hour (1;0;0).
Workshop.

CHE 240. Chemical Process Calculations II. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHE 210 and CHE 230 This course covers the basic principles of energy balances for a variety of engineering systems. Combined with material from other sophomore courses, simple designs of chemical processes are considered. The course also introduces chemical process simulation software.

CHE 240W. Chemical Process Calculations II. 0 credits, 1 contact hour (1;0;0).
Workshop.

CHE 260. Fluid Flow. 3 credits, 3 contact hours (3;0;0).
Prerequisite: CHE 230. Corequisite: CHE 240, MATH 222. This course considers the principles of molecular and turbulent transport of momentum, particularly as they apply to pressure drop calculations in piping systems, packed columns, and other flow devices. Flow around submerged objects is also considered.

CHE 310. Co-op Work Experience I. 3 credits, 3 contact hours (0;0;3).
Restriction: Approval of the department, and permission of the Office of Cooperative Education and Internships. Students gain major related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the Co-op office. Mandatory participation in seminars and completion of a report.Note: Normal grading applies to this COOP Experience.

CHE 311. Co-op Work Experience II. 3 credits, 3 contact hours (0;0;3).
Prerequisite: CHE 310. Restriction: permission of undergraduate advisor. Cannot be used for degree credit. Continuation of CHE 310.

CHE 312. Chemical Process Safety. 3 credits, 3 contact hours (3;0;0).
Restriction: Junior standing. A study of the technical fundamentals of chemical process safety: includes impact of chemical plant accidents and concepts of societal and individual risk; hazards associated with chemicals and other agents used in chemical plants, including toxic, flammable and reactive hazards: concepts of inherently safer design; control and mitigation of hazards to prevent accidents, including plant procedures and designs; major regulations that impact safety of chemical plants; consequences of chemical plant incidents due to acute and chronic chemical release and exposures; hazard identification procedures; introduction to risk assessment.

CHE 342. Chemical Engineering Thermodynamics II. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHE 230, MATH 211 (or MATH 213), CHEM 236. The principles and methods developed in Chemical Engineering Thermodynamics I are extended to multicomponent systems, and used to treat phase and chemical equilibrium as well as such applications as chemical reactors and refrigeration systems.

CHE 349. Kinetics and Reactor Design. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHE 342, CHE 370, MATH 222, CHEM 236. Derive and solve species and energy balances for single chemical reactors; introduces heterogeneous catalysis, non-ideal reactors as ideal reactor combinations, and special topics such as polymeric or biochemical reactions.

CHE 360. Separation Processes I. 2 credits, 3 contact hours (3;0;0).
Prerequisites: CHE 342, CHE 370. This is the first course in separations, examines traditional methods and technologies by which chemical engineers separate and purify mixtures. Emphasis here is on strippers, absorbers, distillations, and extractions.

CHE 365. Techniques for Process Simulation. 2 credits, 3 contact hours (3;0;0).
Prerequisite: CHE 370. Corequisite: CHE 360 Introduction to basic concepts of computational methods for solving chemical engineering problems and performing process simulations. Topics include various numerical techniques for the solution of linear and non-linear algebraic equations and ordinary differential equations, differentiation/integration, and interpolation/regression of data. Students will be exposed to various computational software and commercial process simulators for simulating chemical processes.

CHE 370. Heat and Mass Transfer. 4 credits, 4 contact hours (4;0;0).
Prerequisites: CHE 240, CHE 260, MATH 222. The principles of heat and mass transfer in chemical engineering systems are covered. Steady and unsteady heat transfer is examined, with emphasis on the heat exchanger design. Mass transfer by steady and unsteady molecular diffusion, and turbulent convective mass transfer is studied.

CHE 375. Structure, Properties and Processing of Materials. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHEM 236 or CHEM 235 Tailoring materials properties by engineering their microscopic/macroscopic structures via processing is central to product design and development in the chemical industry. This course introduces the principles of materials engineering from the perspective of structure-property-processing relationships. Instead of covering different types of materials separately, this course will use the principles common to engineering of all important materials as an underlying theme. These are atomic/molecular structure, nanoscale, morphology, principles of phase transformation, structure development during processing, and property dependence on structure. All these topics will be introduced through the paradigm of comparing metals, ceramics and polymers. Besides single component systems, advanced materials such as multiphase and/or multicomponent systems (e.g. composites and gels) and nanomaterials will be discussed based on these principles. An integral part of this course will be the criteria for selection of materials for the chemical process industry.

CHE 380. Introduction to Biotechnology. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHEM 122 or CHEM 126. Basic principles of molecular biotechnology with selected examples of applications.

CHE 396. Chemical Engineering Laboratory I. 3 credits, 5 contact hours (0;5;0).
Prerequisites: CHE 370, ENG 352. Corequisite: MATH 225A. In this first course in chemical engineering capstone laboratory, experiments are conducted in the areas of fluid mechanics and heat transfer. Bench and pilot-scale equipment is used. Oral and written reports are prepared by the students.

CHE 402. Applied Optics in Chemical Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: Junior or senior standing in chemical engineering. Combined laboratory and lecture course emphasizing photonics and laser applications in chemical engineering.

CHE 411. Work Experience III. 3 credits, 3 contact hours (0;0;3).
Prerequisites: CHE 311. Permission of undergraduate advisor. Cannot be used for degree credit. Continuation of CHE 311.

CHE 415. Introduction to 3D Printing. 3 credits, 4 contact hours (2;2;0).
Prerequisites: Junior standing or higher. This course introduces 3D printing technologies including history and basics of 3D printing, currently available 3D printing methods and printable materials as well as current and emerging applications of 3D printing. Students will get a general idea on the major players in 3D printing industry and global effects of 3D printing. The course will be composed of a lecture and a hands-on laboratory session, during which students will create a 3D design and print a functional prototype.

CHE 427. Biotransport. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHE 230 and MATH 222. Introduction to basic concepts of transport phenomena as applied to biological systems. Topics include the structure and composition of the human body, the properties of the blood and its flow in the cardiovascular system, and the body as a heat source and as a series of compartments involved in the mass transfer of materials (such as those in the kidneys and lungs). Students learn to analyze solute transport in biological systems and apply it to the design of biomedical devices.

CHE 444. Introduction to Polymer Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHE 370. Introduction to the basic concepts of polymer engineering. Topics covered include rheology, heat transfer, and kinetics of polymerization reactors.

CHE 460. Separation Processes II. 2 credits, 3 contact hours (3;0;0).
Prerequisites: CHE 360. This second course in separations examines non-traditional methods and technologies such as fixed-bed processes, membranes, crystallization, and mechanical separations.

CHE 472. Process and Plant Design. 4 credits, 4 contact hours (4;0;0).
Prerequisites: CHE 349, CHE 365, CHE 375, CHE 380, IE 492. Corequisite CHE 460. A capstone course in the chemical engineering program. This class is divided into three- or four-person groups. Each group must complete an open-ended process design problem, including equipment specification and economics.

CHE 473. Mathematical Methods in Chemical Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: MATH 222, CHE 349, CHE 360, and CHE 370. An introduction to the use of differential equations to solve chemical engineering problems.

CHE 476. Introduction to Biochemical Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHEM 245, CHE 349. Corequisite: CHE 349. The application of chemical engineering to biochemical processes. Topics include enzyme reactions, dynamics of microbial populations, fermentation equipment, bioreactor design, and sterilization.

CHE 489. Process Dynamics and Control. 3 credits, 4 contact hours (4;0;0).
Prerequisites: CHE 349, CHE 365. This course is an introduction to chemical process dynamics and control. Topics include analysis of the dynamics of open-loop systems, the design of control systems, and the dynamics of closed-loop systems. Control techniques and methodologies, used by practicing chemical engineers, are emphasized.

CHE 490. Special Topics in Chemical Engineering. 3 credits, 3 contact hours (3;0;0).
Prerequisites: CHE 349, CHE 360. Topics of current interest in chemical engineering, such as supercritical fluid extraction, combustion research, environmental problems, biotechnology, technologies in hazardous and toxic substance management, etc. AS interests develop, other topics will be considered.

CHE 491. Research and Independent Study I. 3 credits, 3 contact hours (0;0;3).
Restriction: senior standing in chemical engineering, agreement of a department faculty advisor, and approval of the associate chairperson for undergraduate studies. Normally a GPA greater than 3.0 is required to participate in the course. Provides the student with an opportunity to work on a research project under the individual guidance of a member of the department. A written report is required for course completion.

CHE 492. Research and Independent Study II. 3 credits, 3 contact hours (0;0;3).
Prerequisite: CHE 491. A continuation of CHE 491.

CHE 492H. Research and Independent Study II Honors. 3 credits, 3 contact hours (0;0;3).
Prerequisite: CHE 491. Same as CHE 492, with special projects for Honors students.

CHE 495. Chemical Engineering Lab I. 3 credits, 5 contact hours (0;5;0).
Prerequisites: CHE 370, ENG 352, MATH 225A In this first course in chemical engineering capstone laboratory, experiments are conducted in the areas of fluid mechanics and heat transfer. Bench and pilot-scale equipment is used. Oral and written reports are prepared by the students.

CHE 496. Chemical Engineering Laboratory II. 3 credits, 6 contact hours (0;6;0).
Prerequisites: CHE 349, CHE 360, CHE 380, CHE 396, CHEM 339, MATH 225A. Corequisites: CHE 460, CHE 489. In this second course in chemical engineering capstone laboratory, experiments are conducted in the areas of mass transfer, separations, reaction engineering, and process dynamics and control. Bench and pilot-scale equipment is used. Oral and written reports are prepared by the students.