

CHEMICAL AND BIOLOGICAL ENGINEERING

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Chair

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Faculty with Research Interests

For information regarding faculty visit the Department of Chemical and Biological Engineering website.

The department offers leading edge research and education programs in chemical engineering and biological engineering. These programs are aimed to prepare engineers for the technological challenges of the 21st century by providing students with:

- Fundamental knowledge and design capability in chemical, biological, and environmental engineering, food process engineering, and pharmaceutical engineering
- Advanced research programs in core competency areas
- Understanding of ethical, economic, and social issues that influence technology choices
- Leadership and communication skills
- Life-long learning capabilities

The objective of the undergraduate program is to educate chemical engineering students and prepare them for careers in professional practice and/or for advanced studies at the graduate level. The program specifically aims to develop a new breed of engineers who are not only well schooled in the basics and fundamentals of chemical and biological engineering, but who also possess the skills necessary for success in today's workplace. In recognition of the recent shift of the chemical engineering profession into a more prominent involvement in biotechnology and biological engineering, the department has redesigned the undergraduate curriculum in order to ensure that its graduates will possess additional knowledge and skills in biology and biological engineering as predicated by the changing needs of industry.

Degree Programs

- Bachelor of Science in Chemical Engineering

Co-Terminal Options

The Department of Chemical and Biological Engineering also offers the following co-terminal degrees, which enables a student to simultaneously complete both an undergraduate and graduate degree in as few as five years:

- Bachelor of Science in Biomedical Engineering/Master of Chemical Engineering
- Bachelor of Science in Chemical Engineering/Master of Biological Engineering
- Bachelor of Science in Chemical Engineering/Master of Chemical Engineering
- Bachelor of Science in Chemical Engineering/Master of Engineering in Environmental Engineering
- Bachelor of Science in Chemical Engineering/Master of Food Process Engineering

These co-terminal degrees allow students to gain greater knowledge in specialized areas while, in most cases, completing a smaller number of credit hours with increased scheduling flexibility. For more information, please visit the Department of Chemical and Biological Engineering website (engineering.iit.edu/chbe).

Other Degree Programs in Chemical and Biological Engineering

B.S., M.S., professional master's, and Ph.D. degree programs are offered in chemical engineering. A professional master's degree is offered in biological engineering. M.S. and professional master's degree programs are also offered in chemical engineering/computer science. The department also offers a B.S./M.D. program in engineering and medicine and a combined undergraduate/graduate law program.

Minors

- Minor in Polymer Science and Engineering

Course Descriptions

CHE 100

Introduction to the Profession I

Introduction to chemical engineering and engineering productivity software. Communication skills development, technical reporting and presentation, engineering ethics, and a variety of topics are discussed.

Lecture: 1 Lab: 2 Credits: 2

Satisfies: Communications (C)

CHE 101

Introduction to the Profession II

A continuation of CHE 100. Advanced engineering applications of productivity software. Engineering graphics and technical flow sheeting. Team project research and project management skills. Internet publishing.

Prerequisite(s): CHE 100 or MMAE 100

Lecture: 1 Lab: 2 Credits: 2

Satisfies: Communications (C)

CHE 202

Material Energy Balances

Material and energy balances for engineering systems subjected to chemical and physical transformations. Calculations on industrial processes.

Prerequisite(s): (MATH 152 and CHEM 100-499) and (CS 105 or CS 115 or CS 104)

Lecture: 3 Lab: 0 Credits: 3

Satisfies: Communications (C)

CHE 239

Mathematical and Computational Methods

Utilization of numeric and analytic methods to find solutions to a variety of chemical engineering problems. Emphasis placed on development of computer code, and interpretation of results. Topics covered include systems of algebraic equations, initial value differential equations, and boundary value differential equations.

Prerequisite(s): CHE 202 and MATH 252* and CHE 301*. An asterisk (*) designates a course which may be taken concurrently.

Lecture: 3 Lab: 0 Credits: 3

CHE 296

Introduction to IPRO

Introduction to process design. Principles and techniques in effective teamwork. Performance of selected design tasks in project groups integrated with CHE/IPRO 496. Practice with process design software. First part of CHE/IPRO 296-CHE/IPRO 496 project package. Only CHE students should register for this course.

Prerequisite(s): CHE 202 and CHE 101

Lecture: 0 Lab: 2 Credits: 1

Satisfies: Communications (C)

CHE 301

Fluid Mechanics

Flow of fluids. Fundamentals of fluid flow design equations as applied to selected unit operations.

Prerequisite(s): MATH 252 and CHE 202

Lecture: 3 Lab: 0 Credits: 3

CHE 302

Heat and Mass Transfer Operations

Fundamentals of heat and mass transfer. Heat and mass transfer design equations as applied to selected unit operations. Mass transfer in stage-wise and continuous contacting equipment. Unsteady state operations in mass transfer equipment.

Prerequisite(s): CHE 301

Lecture: 3 Lab: 0 Credits: 3

CHE 311

Foundations of Biological Science for Engineering

This introductory course will introduce engineering students to basic principles of Biological Sciences, which will enable them to understand more advanced courses on the topic and provide a solid base for further study in all life sciences-related topics required in their individual programs.

Prerequisite(s): CHEM 125

Lecture: 3 Lab: 0 Credits: 3

CHE 317

Chemical and Biological Engineering Laboratory I

Laboratory work in the unit operations of chemical engineering, fluid flow, heat transfer, and other selected topics.

Prerequisite(s): CHE 301

Lecture: 1 Lab: 3 Credits: 2

Satisfies: Communications (C)

CHE 351

Thermodynamics I

Laws of thermodynamics and their application to chemical engineering operations.

Prerequisite(s): CHEM 343 and CHE 202

Lecture: 3 Lab: 0 Credits: 3

CHE 406

Transport Phenomena

The equations of change in different coordinate systems (mass, momentum, and energy transport). Velocity distribution in laminar and turbulent flow. Formulation and analytical solutions to the problems of viscous flow, molecular diffusion, heat conduction and convection.

Prerequisite(s): CHE 301 and CHE 302 and MATH 252

Lecture: 3 Lab: 0 Credits: 3

CHE 412

Foundations of Biological Science for Engineering

This introductory course will introduce graduate engineering students to basic principles of Biological Sciences, which will enable them to understand more advanced courses on the topic and provide a solid base for further study in all life sciences-related topics required in their individual programs.

Prerequisite(s): CHEM 125

Lecture: 3 Lab: 0 Credits: 3

CHE 416**Technologies for Treatment of Diabetes**

Study of physiological control systems and engineering of external control of biological systems by focusing on an endocrine system disorder – diabetes. The effects of type 1 diabetes on glucose homeostasis and various treatment technologies for regulation of glucose concentration. Development of mathematical models describing the dynamics of glucose and insulin concentration variations, blood glucose concentration measurement and inference techniques, insulin pumps, and artificial pancreas systems.

Lecture: 3 Lab: 0 Credits: 3

CHE 418**Chemical and Biological Engineering Laboratory II**

Laboratory work in distillation, humidification, drying, gas absorption, filtration, and other areas.

Prerequisite(s): CHE 302 and CHE 317

Lecture: 1 Lab: 3 Credits: 2

Satisfies: Communications (C)

CHE 423**Chemical Reaction Engineering**

Introduction to the fundamentals of chemical kinetics. The design, comparison, and economic evaluation of chemical reactors. Emphasis on homogeneous systems.

Prerequisite(s): CHE 302 and CHE 351 and CHE 433

Lecture: 3 Lab: 0 Credits: 3

CHE 426**Statistical Tools for Engineers**

Descriptive statistics and graphs, probability distributions, random sampling, independence, significance tests, design of experiments, regression, time series analysis, statistical process control, and introduction to multivariate analysis.

Prerequisite(s): MATH 151

Lecture: 3 Lab: 0 Credits: 3

CHE 433**Process Modeling and System Theory**

Principles of process modeling. Modeling of non-reactive and reactive dynamic processes. Transfer functions. Modeling of multistage and non-linear processes. Discrete-event processes, Markov processes, and automata theory.

Prerequisite(s): CHE 302 and CHE 351

Lecture: 3 Lab: 0 Credits: 3

CHE 435**Process Control**

Dynamic process models, stability assessment, feedback, and feed forward control strategies, design and tuning of closed-loop controllers, time domain and frequency domain design and performance assessment methods. Multivariable systems, interaction, multi-loop control. Software for process simulation and controller design.

Prerequisite(s): CHE 302 and CHE 433

Lecture: 3 Lab: 0 Credits: 3

CHE 439**Numerical and Data Analysis**

Utilization of numerical methods to find solutions to a variety of chemical engineering problems. Emphasis placed on problem formulation, development of computer code, and interpretation of results. Techniques covered include: systems of algebraic equations, linear regression, and statistics. Numerical differentiation and integration, solution of ordinary and partial differential equations.

Lecture: 3 Lab: 0 Credits: 3

CHE 451**Thermodynamics II**

Second law analysis of cooling, separation, combustion, and other chemical processes. Chemical reaction equilibrium and processing applications.

Prerequisite(s): CHE 351

Lecture: 3 Lab: 0 Credits: 3

CHE 455**Polymer Processing**

Considerations of transport processes in the polymer industry. Analysis of heat, mass, and momentum transfer in molten polymers and polymer solutions. The polymer flow processes to be discussed will include: extrusion, calendaring, fiber spinning, injection molding, mixing, and polymerization reaction.

Prerequisite(s): CHE 302 and CHE 301

Lecture: 3 Lab: 0 Credits: 3

CHE 465**Electrochemical Energy Conversion**

Thermodynamics, kinetic and mass-transfer fundamentals of electrochemical devices. Potential and potential measurement. Batteries and fuel cells. Fundamentals of corrosion and corrosion prevention.

Prerequisite(s): CHE 302

Lecture: 3 Lab: 0 Credits: 3

CHE 467**Fuel Cell System Design**

System or chemical reactor perspective of fuel cell design. Macro-scale modeling of fuel cell applications. Description of electrode/electrolyte assemblies and the three phase region, polarization curve characterization, analysis of continuous flow systems, typical fuel cell stack configurations, analysis of spatial non-uniformities in stacks, and balance of plant design.

Prerequisite(s): CHE 423

Lecture: 3 Lab: 0 Credits: 3

CHE 470**Introduction to Polymer Science**

An introduction to the basic principles that govern the synthesis, processing and properties of polymeric materials. Topics include classifications, synthesis methods, physical and chemical behavior, characterization methods, processing technologies and applications. Same as CHEM 470 and MMAE 470.

Prerequisite(s): CHEM 124 and MATH 251 and PHYS 221

Lecture: 3 Lab: 0 Credits: 3

CHE 489

Fluidization

Regimes of fluidized beds, rheology behavior of fluidized beds, particle classification, properties of the bubble, emulsion, elutriation, and jet. Fluid mechanic theory and heat and mass transfer in fluidized beds. Design aspects of fluidized beds and pneumatic conveying. Industrial applications of fluidized beds (catalytic reactors, drying, coal conversion, waste treatment).

Prerequisite(s): CHE 302

Lecture: 3 Lab: 0 Credits: 3

CHE 491

Undergraduate Research

Students undertake an independent research project under the guidance of a chemical and biological engineering faculty member.

Credit: Variable

CHE 494

Process Design I

Introduction to design techniques and economic aspects of chemical processes. The technical and economic aspects of equipment selection and design, and alternative methods of operation.

Prerequisite(s): CHE 423* and CHE 435* and CHE 451 and CHE 433, An asterisk (*) designates a course which may be taken concurrently.

Lecture: 2 Lab: 3 Credits: 3

Satisfies: Communications (C)

CHE 496

Process Design II

Group project in process design. Integration of technical, safety, environmental, economic, and societal issues in process development and design. Final part of the IPRO project package. Project teams consist of chemical engineering students and students from other disciplines and professions. Students from other academic units should register for designated section of IPRO 497 (three credits) and their contribution to the project tasks will be defined accordingly.

Prerequisite(s): CHE 494 and CHE 423* and CHE 435*, An asterisk (*) designates a course which may be taken concurrently.

Lecture: 2 Lab: 2 Credits: 3

Satisfies: Communications (C)

CHE 497

Special Projects

Special projects.

Credit: Variable

CHE 498

Chemical Process Safety Design

The purpose of the course is to apply process design disciplines to integrate safety as a principal of the design process. Typical subjects are: thermodynamics of explosions, identification of process hazards, chemical reactivity hazards, dispersion models of release of toxic materials, fires and fire protection, and HAZOP and Fault Tree analysis.

Prerequisite(s): CHE 494

Lecture: 3 Lab: 0 Credits: 3