

# Chemical Engineering

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**Contact Information:**

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**Administration:**

Head of the Department: Vikas Berry  
Director of Graduate Studies: Gang Cheng

**Program Codes:**

20FS0300MS (MS)  
20FS0300PHD (PhD)

The Department of Chemical Engineering offers a program leading to degrees in Chemical Engineering at both the master's and doctoral levels. The primary areas on which this program is based are continuum and molecular transport phenomena, complex fluids and soft matter, nanotechnology, macroscopic and microscopic thermodynamics, chemical kinetics, and process analysis, microelectronic materials and processing, catalysis and surface science, electrochemistry, drug delivery, and biotechnology.

## Admission and Degree Requirements

- MS in Chemical Engineering (<http://catalog.uic.edu/gcat/colleges-schools/engineering/che/ms>)
- PhD in Chemical Engineering (<http://catalog.uic.edu/gcat/colleges-schools/engineering/che/phd>)

**CHE 410. Transport Phenomena. 3 or 4 hours.**

Continuum theory of momentum, energy, and mass transfer. Viscous behavior of fluids. Laminar and turbulent flow. Thermal conduction and convection, diffusion and coupled operations. Course Information: Same as MENG 410. 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CHE 312 or consent of the instructor.

**CHE 413. Introduction to Flow in Porous Media. 3 or 4 hours.**

Theoretical modeling of single-phase and multiphase flow in porous media. Darcy's law and relative permeabilities. Oil production and hydrology. Capillary phenomena. Dispersion and miscible displacement. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CHE 312 or consent of the instructor.

**CHE 421. Combustion Engineering. 3 or 4 hours.**

Combustion chemistry and thermochemistry. Kinetics and mechanism of combustion; ignition and pollutant formation. Detonation and deflagration; premixed and diffusion flames. Surface reaction and droplet combustion. Applications. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CHE 301 and CHE 321.

**CHE 422. Biochemical Engineering. 3 or 4 hours.**

Enzyme-catalyzed and microbially-mediated processes. Free and immobilized enzymes. Batch and continuous cell cultures. Transport phenomena in microbial systems and fermentation processes. Design of biological reactors. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): Consent of the instructor.

**CHE 423. Catalytic Reaction Engineering. 3 or 4 hours.**

Catalytic reactions which occur under conditions for which heat and mass transfer cannot be neglected are considered. Includes porosimetry, surface area measurements and catalyst deactivation. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CHE 321 or consent of the instructor.

**CHE 425. Nanotechnology for Pharmaceutical Applications. 3 or 4 hours.**

Emerging role of nanostructures in drug development and delivery. Principles of nanostructure formation, characterization, surface functionalization, in vitro and in vivo transport, and visualization. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CHE 301 and CHE 311 and CHE 312; or consent of the instructor.

**CHE 431. Numerical Methods in Chemical Engineering. 3 or 4 hours.**

Introduction to the application of numerical methods to the solution of complex and often non-linear mathematical problems in chemical engineering. Includes methods for the solution of problems arising in phase and chemical reaction equilibria, chemical kinetics, and transport. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): Graduate or advanced undergraduate standing.

**CHE 433. Process Simulation With Aspen Plus. 3 or 4 hours.**

Application of Aspen Plus to design, modeling and simulation of process flow sheets. Property models, unit operations, heat integration and pinch analysis, electrolytes, nonconventional solids (e.g., coal), computational aspects. Course Information: CHE 312 and CHE 313 and CHE 321; or consent of the instructor.

**CHE 438. Computational Molecular Modeling. 3 or 4 hours.**

Provide students with a fundamental understanding of the methods, capabilities and limitations of molecular simulations. Course Information: Same as MENG 412. 3 undergraduate hours. 4 graduate hours. Extensive computer use required. Prerequisite(s): CHE 301. Recommended background: Engineering/Science.

**CHE 440. Non-Newtonian Fluids. 3 or 4 hours.**

Fluid mechanics and transport processes involving non-Newtonian fluids. Purely viscous and viscoelastic behavior. Viscometric functions and rheometry. Heat and mass transfer in non-Newtonian fluids. Course Information: Same as MENG 411. 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CHE 410 or MENG 410 or consent of the instructor.

**CHE 441. Computer Applications in Chemical Engineering. 3 or 4 hours.**

Nonnumerical applications of computers: artificial intelligence and expert systems for chemical engineering design and online diagnosis; data acquisition and control for digital process control; process design calculations. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): Senior standing in chemical engineering.

**CHE 445. Mathematical Methods In Chemical Engineering. 3 or 4 hours.**

Advanced mathematical techniques in chemical engineering. Includes infinite series in thermodynamic perturbation theory; Laplace transforms in process control; chemical diffusion transport theories and differential equations. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): MATH 220 or the equivalent.

**CHE 450. Air Pollution Engineering. 3 or 4 hours.**

Environmental aspects of combustion processes, pollutant formation. Control of pollutants and particulates. Air quality control. Fundamentals of combustion. Course Information: Same as ME 450. 3 undergraduate hours. 4 graduate hours. Prerequisite(s): ME 321 or consent of the instructor.

**CHE 451. Renewable Energy Technologies. 3 or 4 hours.**

Fundamentals of renewable energy technologies; solar, wind, biomass. Introduction to energy storage technologies; batteries and fuel cells, and analysis of the hydrogen economy. Course Information: 3 undergraduate. 4 graduate hours.

**CHE 456. Fundamentals and Design of Microelectronics Processes. 3 or 4 hours.**

Design and practical aspects of the most advanced state of micro- and nano-electronics processing with emphasis on thin film deposition, substrate passivation, lithography and etching with thermodynamics, kinetics, reactor design, and optimization. Course Information: Same as MENG 413. 3 undergraduate hours. 4 graduate hours. Extensive computer use required. Prerequisite(s): Graduate standing or consent of the instructor. Recommended background: Engineering/Science.

**CHE 494. Selected Topics in Chemical Engineering. 1-4 hours.**

Systematic study of selected topics in chemical engineering theory and practice. Course Information: May be repeated. Students may register in more than one section per term. Prerequisite(s): Consent of the instructor.

**CHE 496. Undergraduate Senior Design Thesis I. 0-8 hours.**

Introduction to modern process design and development, engineering economics of chemical processes and equipment, process simulation, report writing and presentations, literature survey and undergraduate thesis. Course Information: Extensive computer use required. Prerequisite(s): Consent of the instructor.

**CHE 497. Undergraduate Senior Design Thesis II. 0-8 hours.**

Applications of modern process design principles and design methodology to large-scale chemical processes and plants; team design project with industrial mentor, process simulation, reports, presentations, literature survey and undergraduate thesis. Course Information: Extensive computer use required. Prerequisite(s): Consent of the instructor.

**CHE 499. Professional Development Seminar. 0 hours.**

Students are provided general information about their roles as UIC Chemical Engineering alumni in society and the role of the University in their future careers. Students provide evaluations of their educational experience in the Chemical Engineering Department. Course Information: Satisfactory/Unsatisfactory grading only. Prerequisite(s): Open only to seniors; and approval of the department. Must be taken in the student's last semester of study.

**CHE 501. Advanced Thermodynamics. 4 hours.**

Laws of thermodynamics. General conditions for equilibrium and stability. Thermodynamic potentials. Phase transition and critical phenomena. Principle of irreversible thermodynamics, Onsager's fundamental theorem and engineering applications. Course Information: Prerequisite(s): MATH 220 or the equivalent.

**CHE 502. Fluid Phase Equilibria. 4 hours.**

Application molecular theories of fluids to phase equilibrium systems. Intermolecular potentials, partition functions, correlation functions, chemical potentials, fugacity and activity coefficient and their relationships. Course Information: Prerequisite(s): CHE 301 or equivalent.

**CHE 503. Thermodynamics of Multicomponent Mixtures. 4 hours.**

Thermodynamic theories of mixtures. Molecular principles of various solution theories. Conformal solutions, lattice theories, group contribution function theories, and perturbation and variational theories. Course Information: Prerequisite(s): CHE 502 or the equivalent.

**CHE 505. Advanced Statistical Thermodynamics. 4 hours.**

Development of the principles of statistical mechanics. Calculation of partition functions and properties for the ideal gas including polyatomic gases. Ensemble concepts and interacting subsystems. Applications. Course Information: Prerequisite(s): CHE 502.

**CHE 510. Separation Processes. 4 hours.**

Advanced coverage of equilibrium stage separation. Multi-component separation and distillation; unsteady state adsorption processes. Separation efficiencies and energy requirements. Course Information: Prerequisite(s): CHE 410.

**CHE 511. Advanced Mass Transfer. 4 hours.**

Analysis of diffusion and mass transport in chemical engineering systems. Unsteady state diffusion convective diffusion, mass transfer coefficient dispersion and the study of diffusion and reaction and simultaneous mass transport. Course Information: Prerequisite(s): CHE 410.

**CHE 512. Microhydrodynamics, Diffusion and Membrane Transport. 4 hours.**

Theoretical and numerical fluid mechanics of microstructure: potential flow and virtual mass, quasistatic versus transient Stokes flow, integral theorems, multipole expansions, singularity solutions, fluctuations, and current applications. Course Information: Same as MENG 512. Prerequisite(s): CHE 410 or MENG 410 and CHE 445 or consent of the instructor.

**CHE 514. Biotransport. 4 hours.**

Diffusion and flow in living systems. Blood rheology and flow. Microcirculation, oxygen transport, diffusive transport across membranes. Membrane structure; water, and ion flows, active transport. Course Information: Same as BIOE 514. Prerequisite(s): CHE 410 or consent of the instructor.

**CHE 524. Characterization Techniques in Catalysis. 4 hours.**

The most common crystallographic, spectroscopic, and physicochemical techniques for characterization of bulk solids, solid surfaces, and gas-solid interactions are surveyed. Course Information: Prerequisite(s): Consent of the instructor.

**CHE 527. Advanced Chemical Reaction Engineering. 4 hours.**

Multiplicities in chemically reacting systems nonideal reactors: Effects of residence time distribution and mixing history. Heterogeneous noncatalytic reactions: gas-liquid, liquid-liquid, and solid-fluid systems. Heterogeneous catalytic reactions. Course Information: Prerequisite(s): CHE 321.

**CHE 530. Gas Kinetics. 4 hours.**

Modern theory and experimental methods in the rates of gas reactions. Review of phenomenological kinetics, collision theory, energy transfer, unimolecular reactions, transition state and RRKM theory. Modern applications. Course Information: Prerequisite(s): CHE 505.

**CHE 592. Specialized Problems. 4-8 hours.**

Specialized problems under faculty supervision. Course Information: Prerequisite(s): Consent of the instructor.

**CHE 594. Advanced Topics in Chemical Engineering. 1-4 hours.**

Systematic study of advanced topics in chemical engineering theory and practice. Subjects vary from year to year. Course Information: May be repeated. Students may register in more than one section per term. Prerequisite(s): Consent of the instructor.

**CHE 595. Seminar in Chemical Engineering Research. 1 hour.**

Advances in Chemical Engineering Research will be discussed in a seminar setting. Students will be expected to make presentations in areas of: catalysis, thermodynamics, transport phenomena and kinetics. Course Information: Prerequisite(s): Graduate standing in chemical engineering.

**CHE 597. Project Research. 0-4 hours.**

A research design or reading project approved by the committee appointed by the director of graduate studies. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated. Prerequisite(s): Consent of the instructor. Recommended background: Completed required classes in curriculum.

**CHE 598. M.S. Thesis Preparation. 0-16 hours.**

Individual research in specialized problems under faculty supervision. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated. Prerequisite(s): Consent of the instructor.

**CHE 599. Ph.D. Thesis Preparation. 0-16 hours.**

Individual research in specialized problems under faculty supervision. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated. Prerequisite(s): Consent of the instructor.