Chemical Engineering (CHE)

Courses

CHE 101. Introduction to Chemical Engineering Concepts. 3 hours.
Overview of engineering and chemical principles used in chemical engineering technology. Thermodynamics, transport phenomena, and reaction engineering applied to process and product design. Course Information: Prerequisite(s): Credit or concurrent registration in MATH 180; and Credit or concurrent registration in CHEM 122 and Credit or concurrent registration in CHEM 123.

CHE 150. Climate Engineering for Global Warming. 3 hours.
Overview of the engineering perspective on climate change and strategies to engineer the earth's climate and mitigate risks associated with global warming. *Natural World - No Lab course*.

CHE 201. Introduction To Thermodynamics. 3 hours.
Work and energy; conversion of energy; theory of gases and other states of matter; applications to energy conversion devices. Second Law of thermodynamics, entropy, and equilibrium, with applications. Course Information: Prerequisite(s): MATH 181 and PHYS 141. Class Schedule Information: To be properly registered, students must enroll in one Discussion/Recitation and one Lecture.

CHE 205. Computational Methods in Chemical Engineering. 3 hours.
Computational methods and software relevant to unit operations. Excel spreadsheets (curve fitting, heat conduction), Matlab, Aspen Plus (process simulation), algorithms and object oriented concepts in chemical engineering. Course Information: Prerequisite(s): Credit or concurrent registration in CHE 201; and credit or concurrent registration in MATH 210.

CHE 210. Material and Energy Balances. 4 hours.
Material and energy balances applied to chemical systems. Introduction to chemical and physical properties. Introduction to the use of computers for chemical process calculations. Course Information: Prerequisite(s): Credit or concurrent registration in CHE 201; and credit or concurrent registration in CHE 205.

CHE 230. Molecular Systems in Chemical Engineering. 3 hours.
Introduction to fundamental concepts in molecular engineering and materials chemistry; properties of molecular systems and applications of macromolecules, bio-macromolecules and nanomaterials in energy, medicine, environment and technology. Course Information: Prerequisite(s): CHEM 232.

CHE 301. Chemical Engineering Thermodynamics. 3 hours.
Review of classical engineering thermodynamics. Multicomponent systems & multicomponent phase equilibria. Equilibrium in chemically reacting systems, heterogeneous equilibrium, Gibbs phase rule, and electrochemical processes. Course Information: Prerequisite(s): CHE 201 and CHE 205.

CHE 311. Transport Phenomena I. 3 hours.
Momentum transport phenomena in chemical engineering. Fluid statics. Fluid mechanics; laminar and turbulent flow; boundary layers; flow over immersed bodies. Course Information: Prerequisite(s): Credit or concurrent registration in CHE 210; and MATH 220; and CHE 205.

CHE 312. Transport Phenomena II. 3 hours.
Heat and mass transport phenomena. Heat conduction, convection and radiation. Heat exchanger design. Diffusion. Mass transfer coefficients. Course Information: Prerequisite(s): CHE 311.

CHE 313. Transport Phenomena III. 3 hours.
Mass transfer and phase equilibria. Multistage separations; applications in distillation; extraction; absorption and drying. Course Information: Prerequisite(s): CHE 301.

CHE 321. Chemical Reaction Engineering. 3 hours.
Kinetics of homogeneous single reactions. Ideal reactors: batch, stirred tank and plug flow systems. Conversion and yield in multiple reactions. Design and optimization of reactors. Non-isothermal reactors. Course Information: Prerequisite(s): CHE 210; and MATH 220; and Credit or concurrent registration in CHE 301.

CHE 330. Polymer Science. 3 hours.
Overview of polymer science and engineering. Introduction to polymers as an engineering material; basic concepts of properties; synthesis and structure of polymeric materials, polymer production, property prediction and performance in products. Course Information: Prerequisite(s): CHE 230 or CME 260; and CHEM 232.

CHE 341. Chemical Process Control. 3 hours.
Analysis and design of chemical processes and control systems. Feedback and feedforward controllers. Stability, tuning, and simulation of P-I-D controllers. Introduction to the control of chemical plants and digital process control. Course Information: Prerequisite(s): MATH 220 and CHE 312 and CHE 313 and CHE 321.

CHE 381. Chemical Engineering Laboratory I. 2 hours.
Heat and momentum transfer operations associated with chemical processes. These include heat exchangers, fluid properties, and fluid flow. Technical report writing, computer calculations. Course Information: Prerequisite(s): CHE 312.

CHE 382. Chemical Engineering Laboratory II. 2 hours.
Heat momentum and mass transfer operations associated with chemical processes; these include distillation columns, reactors, humidifiers, and evaporators. Course Information: Prerequisite(s): CHE 381 and concurrent registration in CHE 313.

CHE 391. Chemical Engineering Practicum. 1 hour.
Provides students with the opportunity to apply the skills and knowledge gained in previous engineering courses within a professional, working environment. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated. A maximum of 1 hour awarded toward degree requirements. Prerequisite(s): Approval of the Department.

CHE 392. Undergraduate Research. 1-3 hours.
Undergraduate research project in any area of Chemical Engineering. Projects may be theoretical, experimental, or literature surveys. Course Information: May be repeated. Students may register in more than one section per term. Prerequisite(s): Consent of the instructor.

CHE 396. Senior Design I. 3 or 4 hours.
Introduction to modern, process design and development, engineering economics, and report writing. Design and cost of equipment relating to materials handling to heat transfer, mass transfer, and reactors. Course Information: Continuing students will take the course for 4 hours and students entering after Fall 2020 will take the course for 3 hours. Prerequisite(s): CHE 312 and CHE 313 and CHE 321.

CHE 397. Senior Design II. 4 hours.
Application of principles and design methodology of chemical engineering to the design of large-scale chemical processes and plants. A major design project is assigned for solution and presentation by students working in small groups. Course Information: Extensive computer use required. Prerequisite(s): CHE 396.

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 427. Entrepreneurship in Engineering. 0-4 hours.
Fundamentals of entrepreneurship and technology commercialization for engineers. Introduction to intellectual property, marketing studies, business development, pitching new technology ideas to investors, guidelines for starting a business. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): Junior standing or above. Class Schedule Information: To be properly registered, students must enroll in one Lecture and one Discussion.

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 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 453. Fundamentals of Electrochemistry. 3 or 4 hours.
Introduction to the fundamentals of electrochemistry and its application in a variety of technologies (i.e., batteries, fuel, cells, electrolysis cells). Includes methods for the analysis of cells using electrochemical techniques. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): Consent of the instructor.

CHE 454. Molecular and Macromolecular Engineering. 3 or 4 hours.
Advanced course in polymer science and engineering. Polymerization, polydispersity, molecular configuration, solution properties, thermodynamics, glass and rubbery states, crystallization, viscoelasticity, elastic properties, multiphase systems. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CHE 330.

CHE 455. Nanoscale Systems in Chemical Engineering. 3 or 4 hours.
Basic principles associated with nanoscience and nanotechnology; fabrication and synthesis, size dependent properties, characterization; applications of materials at nanometer length scales; emphasis on recent technological breakthroughs. Course information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CHE 230.

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 457. Colloidal and Interfacial Phenomena. 3 or 4 hours.
Interfacial phenomena in practice: soap bubbles, emulsions, foams, detergents; surface tension driven flows, Marangoni effect; enterfacial rheology; colloids, emulsions, 3D-printing; interfacial thermodynamics, biological interfaces. Course Information: 3 undergraduate hours. 4 graduate hours. Prerequisite(s): CHE 301 and CHE 312.

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 appications. 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 520. Transport Phenomena. 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 510. Previously listed as CHE 410. Prerequisite(s): Consent of the instructor. Recommended Background: B.S. degree in chemical engineering or a related discipline.

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 531. Numerical Methods in Chemical Engineering. 4 hours.
Advance numerical methods to the solution of complex and non-linear mathematical problems in chemical engineering; includes methods to solve problems arising in phase and chemical reaction equilibria, chemical kinetics, and transport. Course Information: Previously listed as CHE 431.

CHE 545. Mathematical Methods in Chemical Engineering. 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: Previously listed as CHE 445. Prerequisite(s): MATH 220 or the equivalent.

CHE 591. Chemical Engineering Internship. 1 hour.
Provides students with the opportunity to apply the skills and knowledge gained in previous engineering courses within a professional, working environment. Course Information: Satisfactory/Unsatisfactory grading only. May be repeated. A maximum of 4 hours awarded toward degree requirements. Prerequisite(s): Approval of the department.

CHE 592. Specialized Problems. 4-8 hours.
Specialized problems under faculty supervision. Course Information: Prerequisite(s): Consent of the instuctor.

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.