

CHEMICAL ENGINEERING • CHE

- 2160 Computer Technology for Chemical Engineering Systems (1) F,S** Prereq.: MATH 1550. Introduction to operating systems, programming techniques, and software packages used in the solution of chemical engineering problems.
- 2171 Chemical Engineering Fundamentals: Material and Energy Balances (3) F,S** Prereq.: MATH 1550 and CHEM 1202. Emphasis on basic principles and concepts used to make chemical engineering calculations; techniques used in these calculations applied to typical industrial problems.
- 2176 Mathematical Modeling of Chemical Engineering Systems (3) F,S** Prereq.: MATH 2090, CHE 2160, and 2171. Basic concepts and techniques in analysis of engineering processes; mathematical description of physical systems and application of modern computers to solution of resulting equations.
- 3100 Chemical Equilibrium and Kinetics of Environmental Processes (3) F** Prereq.: CHE 3172 or ME 3333 or equivalent. Not open to chemical engineering majors. Credit will not be given for both this course and CHE 4190. Introductory chemical thermodynamic concepts extended to heterogeneous equilibrium, dilute solutions, surfaces and colloids of significance in environmental engineering processes; chemical reaction kinetics concepts applied to the environment; applications to waste treatment process design, property estimations for elucidating the fate and transport of chemicals in the environment.
- 3101 Transport Sciences: Momentum Transfer (3) F** Prereq.: CHE 2171, MATH 2090, and credit or registration in CE 2450. Fundamentals of momentum transfer; applications to the fluid problems of engineering.
- 3102 Transport Sciences: Heat and Mass Transfer (4) S** Prereq.: CHE 3101 or CE 2200, and MATH 2065 or 2090. Fundamentals of heat and mass transfer; similarities of heat, mass, and momentum transfer and their interrelation; engineering applications.
- 3104 Engineering Measurements Laboratory (3) F,S** Prereq.: CHE 2176 and credit or registration in CHE 3102. 2 hrs. lecture; 3 hrs. lab. Laboratory work to accompany CHE 3101 and 3102.
- 3171 Process Economics and Optimization (3) F** Prereq.: CHE 2176 and credit or registration in CHE 3102 and 3173. Application of optimization principles to the economic design of chemical engineering unit operations.
- 3172 Chemical Engineering Thermodynamics (3) F** Prereq.: CHE 2171. Basic concepts and chemical engineering applications of thermodynamics; emphasis on flow processes and real gas thermodynamics.
- 3173 Heterogeneous Equilibrium (3) S** Prereq.: CHE 3172. Theory of vapor-liquid, liquid-liquid, and solid-liquid equilibrium, including the effects of chemical reactions; application of thermodynamic theory to the correlation of equilibrium data and the prediction of equilibrium compositions.
- 3249, 3250 Engineering Practice (1-3, 1-3) Su only** Prereq.: consent of instructor. Pass-fail grading. A minimum of 6 weeks of full-time employment by an industry participating in the summer program. Selected engineering problems in an industrial environment.
- 3271, 3272 Senior Projects (1-2, 1-2) Prereq.: consent of department. Pass-fail grading.** Experimental and theoretical investigations including library research.
- 4151 Unit Operations Design (4) F** Prereq.: CHE 3102, 3171, and 3173. 3 hrs. lecture; 3 hrs. lab. Unit operations analyzed as applications of chemical engineering fundamentals and transport sciences; use of these principles in design calculations.
- 4162 Unit Operations Laboratory (3) F,S** Prereq.: CHE 3104 and credit or registration in CHE 4151. 1 hr. lecture; 6 hrs. lab. Obtaining and interpreting data needed to solve typical problems in design or operation of chemical engineering equipment.
- 4172 Process Design (4) S** Prereq.: CHE 4151 and 4190. 3 hrs. lecture; 3 hrs. lab. Chemical plant design from initial concept through preliminary estimate; flow diagrams, equipment cost estimation, economic analysis, safety, and environmental issues; computer-aided process design.
- 4190 Chemical Reaction Engineering (3) F** Prereq.: CHE 3102 and 3173; or equivalent. Basic principles of reactor design; selection of best design alternatives; achievement of optimum reactor operation.
- 4198 Process Dynamics (3) S** Prereq.: CHE 3171 and credit or registration in CHE 4151. Principles and practices of process dynamics and automatic control; mathematical modeling of process dynamics, feedback control, and feed forward control.
- 4204 Technology of Petroleum Refining (3) F** Prereq.: credit or registration in CHE 4151. Catalytic and thermal processes used in petroleum refining; application of scientific and engineering principles in processes such as catalytic cracking, reforming, coking, alkylation, isomerization, and hydroprocessing; emphasis on applied catalysis and its impact on engineering design.
- 4205 Technology of Petrochemical Industry (3) Prereq.: CHE 4151.** Processes used in the manufacture of petroleum-based chemicals; application of scientific and engineering principles involved in the production of hydrogen, alcohols, olefins, aromatics, aldehydes, ketones, acids, rubber, and other polymers; emphasis on catalysis by transition-metal complexes.
- 4210 Industrial Catalysis (3) Prereq.: credit or registration in CHE 4190.** Principles of the industrial utilization of heterogeneous catalysis; topics include absorption phenomena, methodology in catalyst preparation, characterization and evaluation of catalysts, diffusion and reaction in porous catalysts, and a survey of major industrial processes.
- 4221, 4222 Senior Research (1,2) Prereq.: credit or registration in 3102, 3104, and 3173, gpa of at least 2.8 (in CHE) and consent of instructor. CHE 4221 is a prerequisite for 4222. Not open to graduate students. 1 hr. lecture (4221); 6 hrs. lab (4222).** Comprehensive research or development project of a theoretical or experimental nature, involving a team effort over two semesters (spring and fall periods).
- 4253 Introduction to Industrial Pollution Control (3) Prereq.: CHE 3102 or equivalent introductory course in transport science.** Quantitative application of chemical engineering principles to removal of objectionable components from effluents, with emphasis on industrial processing effluents; currently available techniques for controlling air and water pollution and solid wastes; concept of pollution control through basic process alterations developed by specific examples.
- 4260 Biochemical Engineering (3) Prereq.: credit or registration in CHE 4190 or equivalent.** Application of chemical engineering fundamentals to microbiological and biochemical systems; problems peculiar to industrial operations involving microbial processes; growth conditions and requirements, metabolisms, product separations, enzyme catalysis, sterilization, and aseptic operations.
- 4263 Environmental Chemodynamics (3) Prereq.: CHE 3102 or equivalent introductory course in transport science.** Environmental chemodynamics: interphase equilibrium, reactions, transport processes and related models for anthropogenic substances across natural interfaces (air-water-sediment-soil) and associated boundary regions.
- 4270 Processing of Advanced Materials (3) Prereq.: CHE 3102 or equivalent transport course.** Treatment of coupled chemical reaction and mass, energy, and momentum transport in the manufacturing and processing of semiconductors and advanced ceramic materials; engineering models for chemical and physical vapor deposition methods and condensed phase processes.
- 4272 Chemical Processing of Nanomaterials (3) Prereq.: CHE 3102 or equivalent introductory course in transport science.** Chemical engineering principles applied to preparation, handling, and applications of nanomaterials. Emphasis will be on manufacturing and processing steps. Case studies will be developed to focus on specific device or material applications.
- 4275 Electrochemical Engineering (3) Prereq.: CHE 3102 or equivalent introductory course in transport science.** Principles of electrochemistry applied to engineering problems; potential distribution theory, kinetics, mass transport, and thermodynamic principles; quantification of controlling factors in microfabrication, corrosion, battery design, and electrochemical synthesis.
- 4285 Principles of High Polymers (3) Prereq.: CHE 3172 and CHEM 3491.** Solution and solid-state properties of high polymers; microstructure of polymer chains and effect on macromolecular physical properties of the final plastics.
- 4296 Development of Mathematical Models (3) Prereq.: CHE 2176 and 3102; or equivalent.** Mathematical descriptions of systems encountered in chemical engineering developed from basic principles; lumped parameter systems, distributed parameter systems, formulation of ordinary and partial differential equations, continuous and discrete analogs, and matrix formulations; models developed for systems ranging from simple elements to plant-scale.
- 4410 Special Topics in Chemical Engineering Design (3) May be taken for a max. of 6 sem. hrs. when topics vary.** One or more phases of current chemical engineering design.
- 4420 Special Topics in Chemical Engineering Science (3) May be taken for a max. of 6 sem. hrs. when topics vary.** One or more phases of current chemical engineering science.
- 7100 Chemical Engineering Fluid Mechanics (3) Foundations of continuum fluid mechanics and the equations of motion; solution methods for lubrication flows, creeping flows, boundary layer problems, laminar flows with strong convection; introduction to selected topics including: turbulence, non-Newtonian fluids, interfacial flows, computational fluid dynamics, microfluidics, particle motion, droplet dynamics.**
- 7110 Mathematical Methods in Chemical Engineering (3) F** Review of physicochemical problem formulation; analytical and approximate techniques for the solution of linear and nonlinear differential equation models in chemical engineering systems.
- 7120 Chemical Engineering Thermodynamics (3) F** Thermodynamic properties, first and second laws of thermodynamics, entropy, Maxwell relations, and relationship of thermodynamic properties to intermolecular forces; physical equilibrium with emphasis on partial free energy, fugacity, Raoult's law, K-values, equations of state, and activity coefficients; chemical equilibrium and free energies; fundamentals of statistical mechanics.
- 7130 Fundamentals of Transport Phenomena (3) S** Foundations of heat and mass transport in continua; modeling and solution techniques; transport by diffusion, convection, and turbulence; forced convection; buoyancy-driven transport; introduction to computational modeling.
- 7140 Chemical Reactor Design Methods (3) S** Basic principles of chemical kinetics, fluid flow, heat transfer, and mass transfer used in design of chemical reactors; chemical equilibria, chemical kinetics, design of isothermal reactors, effects of nonideal flow, nonisothermal reactors, and solid-gas catalytic reactions.
- 7314 Optimization (3) Techniques of optimization including analytical methods, linear and nonlinear programming, geometric and dynamic programming, and variational methods with application to systems of interest to chemical engineers.**
- 7352 Distillation and Other Separation Processes (3) Mathematical models, phase equilibria, and calculation procedures related to design and behavior of distillation columns, absorbers, extractor-settlers, etc.; emphasis on computer techniques.**

7512 Advanced Chemical Engineering Analysis (3) Prereq.: CHE 7110 or equivalent. May be taken for a max. of 6 hrs. of credit with consent of department. Topics in chemical engineering analysis, such as perturbation methods, matched asymptotic expansions, vector and tensor calculus, and numerical techniques.

7522 Advanced Chemical Engineering Thermodynamics (3) Prereq.: CHE 7120 or equivalent. May be taken for a max. of 6 hrs. of credit with consent of department. Thermodynamics of chemical engineering processes, such as nonequilibrium thermodynamic properties.

7532 Advanced Chemical Engineering Fluid Mechanics (3) Prereq.: CHE 7100 or equivalent. May be taken for a max. of 6 hrs. of credit with consent of department. Chemical engineering flow processes, such as turbulence, boundary layer theory, hydrodynamic stability, compressible flow, multiphase flow, chemically reacting flows, and non-Newtonian and viscoelastic fluids.

7534 Advanced Chemical Engineering Heat Transfer (3) Prereq.: CHE 7130 or equivalent. May be taken for a max. of 6 hrs. of credit with consent of department. Chemical process heat transfer; phase change and moving boundary problems; heat transfer mechanisms, natural and forced convection, radiation, and combined heat and mass transfer.

7536 Advanced Chemical Engineering Mass Transfer (3) Prereq.: CHE 7130 or equivalent. May be taken for a max. of 6 hrs. of credit with consent of department. Transport of mass in chemical engineering processes, such as diffusional operations, models for mass transfer in multicomponent, multiphase, stationary, flowing, and reacting systems.

7542 Catalysis (3) Prereq.: CHE 7140 or equivalent. Heterogeneous catalysis; adsorption phenomena, physical methods, solid state spectroscopies, and reaction mechanisms as applicable to fundamental and industrially significant processes.

7544 Chemical Kinetics and Reaction Mechanisms (3) Prereq.: CHE 7140 or equivalent. Gas-phase reactions and modern approach to deduction of reaction mechanism; collision, transition state, RRK, and RRKM theories, bond energy correlations, kinetics of complex reaction systems, fast reactions, computer modeling, and sensitivity analysis.

7572 Advanced Automatic Process Control (3) Prereq.: CHE 4198 or equivalent. Recent developments in control theory applied to control schemes in industrial processes; techniques of state space analysis, nonlinear stability criteria, multivariable control, and system identification.

7574 Digital Control of Processes (3) Prereq.: CHE 4198 or equivalent. Theory and use of digital computers for process control; relationships between computer and process control schemes, control algorithms, valve dynamics, modeling techniques.

7582 Polymerization and Polycondensation Processes (4) Prereq.: CHEM 4160 or 4562 or CHE 4285 or equivalent. 3 hrs. lecture; 3 hrs. demonstration/lab. Also offered as CHEM 7261. Preparation and characterization of high polymers; typical commercial procedures for plastics production.

7592 Design Problems in Chemical Engineering (3) Prior to registration students should discuss a prospective design problem with faculty member under whom they plan to study and obtain departmental approval. Design problem cannot be directly related to student's research. Integration of technology into design of systems or plants for accomplishing specific objectives; emphasis on producing a design package considering technical, economic, manning, and scheduling aspects of the project.

7594 Advanced Computer-Aided Process Design (3) Prereq.: CHE 4172 or equivalent. May be taken for a max. of 6 hrs. of credit with consent of department. Computer-aided process design and simulation of chemical process industries, such as sequential modular flow sheeting, simultaneous solution schemes, decomposition strategies, and various simulation languages.

7700 Advanced Topics in Chemical Engineering (3) May be taken for a max. of 9 hrs. of credit with consent of instructor. One or more phases of advanced chemical engineering practice.

8000 Thesis Research (1-12 per sem.) "S"/"U" grading.

9000 Dissertation Research (1-12 per sem.) "S"/"U" grading.
