Chemical Engineering Courses

Undergraduate

ChE 121 Chemical Reaction Engineering After consideration of chemical reaction kinetics and thermodynamics, the course focuses on the design relationships for batch, semi-batch, plug-flow and mixed reactors. The application of these design relationships is explored in ideal, isothermal, non-isothermal, adiabatic reactors. Homogeneous, heterogeneous and biological systems are discussed including the effect of transport phenomena on reaction rates and reactor design. 3 credits. Prerequisite: ESC 140.

ChE 131 Advanced Chemical Engineering Thermodynamics Concept of fugacity in imperfect gases; chemical potential and partial molar properties in mixtures; Gibbs-Duhem Equation; ideal solutions of imperfect gas mixtures; the Lewis and Randall Rule; methods of calculating activity coefficients in non-ideal mixtures; vapor-liquid equilibria; checking thermodynamic consistency of vapor-liquid equilibrium data; equilibrium constant, enthalpy change and Gibbs free energy of formation in chemical reactions. 3 credits. Prerequisite: ESC 130.1.

ChE 141 Heat Transmission Thermal conductivity; steady state conduction in solids and heterogeneous materials; transient conduction; convective heat transfer; heat transfer during boiling and during condensation; design of heat-exchange equipment; radiation heat transfer. 3 credits. Prerequisite: ESC 140.

ChE 142 Mass Transfer Operations Diffusion mechanisms and phenomena; estimation of diffusivity; Fick’s law of diffusion; concentration distributions in solid and fluid flow with or without chemical reaction. Application of thermodynamic and transport concepts to the design of continuous-contact and staged mass transfer processes. Distillation, gas absorption and drying. Examination of the limitations of theory and empiricism in design practice. 4 credits. Prerequisites: ChE 131, ChE 141 and ESC 140.

ChE 151 Process Simulation and Mathematical Techniques for Chemical Engineers In this course computer-aided design is applied to chemical engineering problems in fluid flow, heat transfer, mass transfer and chemical reactor analysis. Topics include: matrices and determinants properties and special matrices, systems of linear equations and methods of solution by matrices, eigenvalues, eigenvectors and applications to least squares and stage processes. Steady and unsteady general diffusion equation, one- and two-dimensional heat transfer equation, Fourier series, Laplace and Z transforms and applications. Series and numerical solutions. Power, Bessel, Euler, Runga-Kutta, Milne, Finite differences approximations and Crank-Nicholson. Applications. 3 credits.

ChE 152 Chemical Process Dynamics and Control Introduction to process dynamics and principles of control in chemical engineering applications; block diagram notation, input disturbance, frequency response and stability criteria for chemical equipment and chemical reaction systems; single- and multiple-loop systems; phase plane analysis of reaction systems; application of analog computer in solution of problems. 3 credits. Prerequisite: ChE 151.

ChE 161.1 Process Evaluation and Design I The course uses design projects to explore process flow diagrams and initial equipment design estimates based on process and unit operation material and heat balances. Studies include equipment cost estimation methods that are developed into process economic evaluations and profitability analysis. The course concludes with process and equipment design using Simulation Science’s PRO/VT and an examination of optimization techniques. 3 credits each. Prerequisites: ChE 141 and ChE 121.

ChE 161.2 Process Evaluation and Design II This is a continuation of ChE 161.1, and is the “capstone design course” in Chemical Engineering. All aspects of Chemical Engineering are integrated in the design of a chemical process plant. The design process consists of flow-sheet development, equipment selection and sizing, utility requirements, instrumentation and control, economic analysis and formulation of safety procedures. The plant design is carried out in class and includes the use of professional simulation packages. The AICHE project is included in this course. 3 credits. Prerequisite: ChE 161.1

ChE 162.1-162.2 Chemical Engineering Laboratory I & II This laboratory course emphasizes the application of fundamentals and engineering to processing and unit operations. The experiments range from traditional engineering applications to new technologies and are designed to provide hands-on experiences that complement the theories and principles discussed in the classroom. Preparation of detailed project reports and oral presentations are important components of this course. 1.5 credits each. Prerequisite: ChE 121, ChE 141; co-requisite: ChE 142.

ChE 311 Introduction to Polymer Technology Introduction to the chemistry and physical status of polymer materials. Discussion on formation of polymers from corresponding monomers, emphasizing mechanism and kinetics of various polymerization techniques. Measurements of average molecular weights and molecular weight distribution of polymers. Viscosity and rheology of polymer solutions and melts. 3 credits

ChE 321 Chemical Reactor Design Design and analysis of chemical reactor systems; transport phenomena; reactor dynamics; design optimization; experimental techniques. 3 credits. Prerequisite: ChE 121.

ChE 340 Industrial Waste Treatment This course deals with the treatment of industrial waste streams. Topics include: sources of wastewater, characterization of industrial wastewater, BOD, COD, TOC, The OD, primary treatment by physical unit operations (coagulation and flocculation, sedimentation, flotation, thickeners, filtration, absorption, …). Secondary treatment by unit processes (ion exchange, chlorination, de-chlorination,…), biological treatments (Kinetics and reactor design, aerobic, anaerobic,…), industrial applications and municipal and government regulations. This course is 50% engineering science, 50% engineering design. The course also includes a research paper on an environmental topic. 3 credits. Prerequisite: Ch 160.

ChE 342 Separation Processes Advanced study of the theory and design of multi-component distillation, gas absorption and extraction operations. Thermal diffusion, foam fractionation, parametric pumping, reverse osmosis and chromatographic separations are examples of less conventional operations discussed. Thermodynamics of phase-equilibrium; diffusion and low- and high-flux mass transport theory. 3 credits. Prerequisite: ChE 151.

ChE 391 Research Problem I An elective course available to qualified and interested students recommended by the faculty. Students may select problems of particular interest in some aspect of theoretical or applied chemical engineering. Topics range from highly theoretical to completely practical, and each student is encouraged to do creative work on his or her own with faculty guidance. 3 credits. Prerequisite: senior standing.

ChE 392 Research Problem II Continuation of ChE 391. 3 credits. Prerequisite: ChE 391.

ChE 393 Research Problem 111 Continuation of ChE 392. 3 credits. Prerequisite: ChE 392.

ChE 394 Research Problem IV Continuation of ChE 393. 3 credits. Prerequisite: ChE 393.

Graduate

ChE 411 Polymer Technology and Engineering Structures and synthesis of Carbon-Carbon and heterogeneous chain polymers, mechanisms and kinetics of emulsion, condensation, ionic stereo-specific polymerizations. Rubber elasticity. Rheological and viscoelastic properties of polymers and polymer solutions. Survey and investigations of advanced topics are required. 3 credits. Prerequisite: permission of instructor.

ChE 421 Advanced Chemical Reaction Engineering Principles and practices of chemical reaction systems emphasizing heterogeneous chemical kinetics, coupled heat and mass transfer in reacting systems and reactor dynamics. Modeling and simulation of systems are extensively applied. 3 credits. Prerequisite: ChE 121.
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<td>ChE 432</td>
<td>Advanced Chemical Engineering Thermodynamics and Molecular Theory</td>
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<td>ChE 433</td>
<td>Transport Processes in Internal Combustion Engines</td>
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<td>ChE 434</td>
<td>Special Topics in Combustion (same as ME 434)</td>
<td>3 credits. Prerequisite: ME334 or permission of instructor.</td>
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<td>ChE 435</td>
<td>Advanced Fluid Mechanics (same as EID and ME 435)</td>
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**ChE 430 Thermodynamics of Special Systems**

Principles of digital simulation for chemical processes and other engineering problems are introduced. Groups of subroutines as essential tools for dynamic simulation and evaluation are developed. Projects involving advanced dynamic simulations of chemical engineering systems are required.

3 credits. Prerequisite: permission of instructor.

**ChE 432 Advanced Chemical Engineering Thermodynamics and Molecular Theory**

Modern methods of applying thermodynamics and molecular physics to phase behavior of fluid mixtures, intermolecular forces and thermodynamic properties, molecular dynamic properties, molecular theory of gases and liquids, theories of liquid solutions and fluid mixtures at high pressures.

3 credits. Prerequisite: ChE 131.

**ChE 433 Transport Processes in Internal Combustion Engines**

3 credits. Prerequisite: permission of instructor.

**ChE 434 Special Topics in Combustion**

3 credits. Prerequisite: ME334 or permission of instructor.

**ChE 435 Advanced Fluid Mechanics**

3 credits. Prerequisite: permission of instructor.

**ChE 437 Advanced Heat and Mass Transfer**

3 credits. Prerequisite: ESC 140 and permission of instructor.

**ChE 438 Multi-component Distillation**

Various methods for vapor-liquid equilibrium calculations, including the Wilson parameter approach, are reviewed. Distillation tower design based on steady-state approach includes analytical method using matrix operation and various convergence methods are discussed in detail. Introduction to unsteady-state approach for tower design and dynamics evaluation. Students are encouraged to apply existing techniques to complex towers and to improve the state of the art.

3 credits. Prerequisite: ChE 142.

**ChE 439 Boundary Layer Theory**

Study of heat, mass and momentum transfer in the boundary layer region of a submerged body; emphasis on continuum fluid systems, with introduction to rafied and non-continuum gaseous systems; analytical, numerical and analog methods of solutions.

3 credits. Prerequisite: ESC 141.

**ChE 440 Advanced Fluid Mechanics**

3 credits. Prerequisite: permission of instructor.

**ChE 441 Advanced Heat and Mass Transfer**

3 credits. Prerequisite: ESC 141.

**ChE 442 Multi-component Distillation**

Various methods for vapor-liquid equilibrium calculations, including the Wilson parameter approach, are reviewed. Distillation tower design based on steady-state approach includes analytical method using matrix operation and various convergence methods are discussed in detail. Introduction to unsteady-state approach for tower design and dynamics evaluation. Students are encouraged to apply existing techniques to complex towers and to improve the state of the art.

3 credits. Prerequisite: ChE 142.

**ChE 443 Advanced Experimental Process Control**


3 credits. Prerequisite: ChE 152

**ChE 444 Boundary Layer Theory**

Study of heat, mass and momentum transfer in the boundary layer region of a submerged body; emphasis on continuum fluid systems, with introduction to rafied and non-continuum gaseous systems; analytical, numerical and analog methods of solutions.

3 credits. Prerequisite: ESC 141.

**ChE 445 Digital Simulation**

Principles of digital simulation for chemical processes and other engineering problems are introduced. Groups of subroutines as essential tools for dynamic simulation and evaluation are developed. Projects involving advanced dynamic simulations of chemical engineering systems are required.

3 credits. Prerequisite: permission of instructor.

**ChE 446 Chemical Process Optimization**

Various algorithms of optimization techniques are introduced. Methods covered include both analytical and numerical approaches. Applications to optimal reactor design. Optimal control of chemical process equipment performance is demonstrated. Solution by students of assigned optimization problems in chemical engineering on digital or analog computers is required.

3 credits. Prerequisite: ChE 451.

**ChE 447 Digital Computer Process Control**

An introductory course in digital computer control. Topics discussed include basic mathematics of sampling data systems; control algorithms using transformation; direct digital control; supervisory control; application of the digital computer to advanced control and optimal control. Analog to digital and digital to analog conversions, acquisition of laboratory data and remote control of experimental equipment are also covered.

3 credits. Prerequisite: ChE 152.

**ChE 448 Advanced Experimental Process Control**


3 credits. Prerequisite: ChE 152

**ChE 449 Thesis/Project**

Master’s candidates are required to conduct, under the guidance of a faculty advisor, an original investigation of a problem in chemical engineering, individually or in a group, and to submit a written thesis describing the results of the work.

6 credits for full year.