CHEMICAL ENGINEERING CHE
College of Engineering

222. Pollution of the Environment--Causes and Cures
   Spring, 3(3-0) Nonmajors: no science or technical background required.

290. Transport Phenomena and Physical Properties Laboratory
   Fall, 3(3-0) CHE 307 or concurrently.
   Experiments involving the transport processes and measurement of physical, chemical and
thermodynamic properties of various materials. Comparison of theoretical and experimental re-
results.

300. Material and Energy Balances
   Fall, 4(3-2) One year general chemistry, MTH 214 or concurrently, CPS 120 or con-
currently.

305. Transfer Processes and Separations I
   Fall, 4(3-2) MTH 215, CHE 300 or concurrently.
   Thermodynamics of fluid flow. Treatment of fluid flow as a momentum transfer process.
   Laminar and turbulent motion of compressible and incompressible fluids. Heat transfer in solids and
   flowing fluids.

306. Transfer Processes and Separations II
   Winter, 4(3-2) CHE 305.
   Heat transfer in condensing and boiling systems. Multiple effect evaporation. Radiation heat trans-
fer. Application to engineering equipment. Mass transfer in single-phase systems, transport
   analogies interphase transfer and contacting of immiscible phases.

307. Transfer Processes and Separations III
   Spring, 4(3-2) CHE 306.
   Mass transfer in continuous contacting systems and stagewise processes. Counter-current pro-
cesses, fractionation, contacting, efficiency, and simultaneous momentum, heat, and mass trans-
fer.

311. Thermodynamics for Chemical Engineering
   Spring, 3(3-0) CEM 361.
   First and second laws. Energy, enthalpy, entropy, free energy, the mathematics of property

381. Chemical Engineering Analysis
   Fall, Spring, 3(3-0) Students may not receive credit in both CHE 391 and MTH 341.
   Interdepartmental with the Department of Mathematics.
   Formulation of ordinary and partial differential equations describing chemical systems. Bound-
ary value problems, numerical methods, matrices, and applications, to chemical engineering
   systems.

411. Phase and Chemical Equilibria
   Fall, 3(3-0) CHE 311.
   Properties in solutions. Deviations from ideality. Liquid-vapor equilibria. Chemical equilibria in
   the gas, liquid, and solid states. Electrochemical and irreversible systems.

423. Chemical Engineering Laboratory
   Spring, 3(1-6) CHE 307 or concurrently.
   Assigned laboratory problems, requiring team effort. Experimenal work, involving momen-
tum, heat and mass transfer; separation pro-
cesses, such as distillation, filtration, and drying; reactor kinetics; automatic process control.

424. Transport Phenomena and Physical Properties Laboratory
   Fall, 3(3-0) CHE 307.
   Experiments involving the transport processes and measurement of physical, chemical and
thermodynamic properties of various materials. Comparison of theoretical and experimental re-
results.

425. Chemical Reaction Engineering
   Fall, 3(3-0) CEM 361 or approval of department.
   Quantitative treatment of mechanisms and rates of chemical reactions. Catalysis. Design and
   analysis of flows and non-flow reactors. Interpretation of laboratory kinetic data.

442. Polymer Science and Engineering
   Winter, 3(3-0) One year organic chemistry, CEM 361.
   Structure of polymers. Polymerization reaction kinetics. Polymer characterization. Solution
   rheology. Polymer processing and fabrication. Commercial polymerization processes.

443. Chemical Engineering of the Solid State
   Spring, 3(3-0) CEM 361.
   Structure and properties of inorganic and organic solids. Relation of bond type and steric con-
figuration to mechanical, electrical, thermal, optical properties. Macroscopic structure influ-
ence on physical properties. Surface phenomena. Applications.

446. Polymerization
   Fall, 3(3-0) One year organic chemistry, elementary physical chemistry. Inter-
departmental with and administered by the De-
partment of Chemistry.
   Formation and characterization of polymers of high molecular weight will be emphasized.

451. Process Systems Control
   Winter, 3(3-0) CHE 425.
   Foundation of control theory for chemical processes. Integration of present and developing practice with modern theory.

460. Problems and Reports
   Fall, Winter, Spring, 3 credits.
   Senior, approval of department.
   Library and laboratory investigations of prob-
lems relating to departmental research.

461. Process Selection and Optimization
   Winter, 3(5-0) CHE 307.
   Application of chemical engineering principles in design calculations. Selection of the optimum design for equipment, conceptual units, and for the overall process. Influence of design on capi-
tal investment, operating cost, product loss, and product quality.

462. Process Design
   Spring, 3(1-6) CHE 461.
   Integrated design of the complete chemical en-
geering process. Process engineering, project engineering, instrumentation, and layout.

465. Process Optimization Methods
   Fall, Spring, 3(3-0) CHE 307, knowledge of linear algebra. Interdepartmental with Systems Science.
   Methods for determining optimum design and operating policies of systems of varying complex-
ity. Includes classical methods, mathematical programming and modern methods.

470. Theory of Nuclear Reactors
   (82.) Winter, 3(3-0) PHY 289 and MTH 215 or approval of department.
   Theory and design of nuclear research and power reactors. Nuclear transformation, fission, and energy conversion. Derivation of chain reaction design criteria, and calculation of flux-power distribution. Analysis of reactor safety, reliability and economics.

481. Transport Phenomena
   Winter, 3(3-0) CHE 307, CHE 381.
   Fundamental treatment of momentum, energy and mass transport. Use of partial differential equations and equations of change for chemical engineering applications. Analogies among the phenomena, dimensional analysis, and bound-
ary layer theory.

501. Advanced Chemical Engineering Calculations I
   Fall, 3(3-0) CHE 307.
   Advanced chemical engineering applications of advanced mathematical methods. Formulation and solution of mathematical equations which describe physical problems. Computer solutions.

502. Advanced Chemical Engineering Calculations II
   Winter, 3(3-0) CHE 301.
   Continuation of CHE 301.

506. Thermodynamics and Kinetics in Chemical Engineering
   Summer, 3(3-0) B.S. with a major in chemistry, biochemistry, or a closely allied area.
   Mathematics through calculus. College level physics. General physical, and organic chemis-
try. Not open to students with B.S. in chemical engineering for graduate credit.

507. Transfer and Separation Processes
   Summer, 3(3-2) B.S. with a major in chemistry, biochemistry, or a closely allied area.
   Mathematics through calculus. College level physics. General physical, and organic chemis-
try. Not open to students with B.S. in chemical engineering for graduate credit.

508. Transport Phenomena
   Summer, 3(3-2) B.S. with a major in chemistry, biochemistry, or a closely allied area.
   CHE 307. Not open to students with B.S. in chemical engineering for graduate credit.

Diffential equations of motion, continuity, energy and mass. Concepts of fluid behavior. Un-
811. Advanced Chemical Engineering Thermodynamics I
Fall, 3(3-0) CHE 311, CHE 411. CEM 361
Advanced treatment of the laws of thermodynamics, Cyclic processes. Corresponding state and higher parameters in computing properties of chemical compounds and solutions.

817. Advanced Chemical Reaction Engineering I

825. Theory, Applicability and Engineering of Radioisotopes
Winter of even-numbered years. 3(3-0) PHY 498 or PHY 430 or approval of department. Principles of utilization of radioisotopes in research and production problems for engineering and scientific studies. Fundamentals and preparation techniques of radioisotopes. Selection, specification, measurement and disposal for typical technical problems.

826. Flow of Heat I
Spring, 3(3-0) CHE 307. Steady and unsteady state heat transfer. Conduction and convection in flow and non-flow systems.

831. Distillation, Absorption, and Extraction—Ideal Stages

832. Distillation, Absorption and Extraction—Phase Contractors
Winter, 3(3-0) CHE 307. May precede or follow CHE 831. Mass transfer in distillation, absorption, and extraction processes. Continuous and stagewise phase contractors. Column hydrodynamics and plate efficiency.

835. Nonlinear Optimization Models
SY 828; Winter, Summer, 4(4-0) Students may receive credit for both SYS 835 and MGT 855. CHE 465 or CHE 534 or knowledge of linear programming. Interdepartmental with Systems Science and the Department of Management. Jointly administered by Systems Science and the Department of Management. Nonlinear optimization-examples and applications. Kuhn-Tucker Theory. Saddle point optimality conditions. Algorithms for problems with constraints. Unconstrained optimization; introduction to search methods.

841. Advanced Transport Phenomena
Spring, 3(3-0) MTH 215, B.S. in engineering or physical science. Use of equations of change in solving engineering problems. Boundary layer and penetration theories of interface transport. Potential flow. Turbulence from a statistical standpoint.

847. Physical Chemistry of Macromolecules
Winter of odd-numbered years. 3(3-0) CHE 446 or approval of department. Interdepartmental with the Department of Chemistry.
Thermodynamics—equilibrium of polymer solutions; conformation and conformation of chain molecules; characterization of polymer molecular weight and distribution; theoretical and experimental results for dilute solution viscosity and diffusivity; polyelectrolytes.

881. Seminar
Fall, Winter, Spring, Summer, 1-0-2) May reenroll for a maximum of 3 credits allowed toward M.S. degree and 6 credits toward Ph.D. degree. Detailed library investigation of one or more specialized aspects of chemical engineering, such as recent theoretical developments in one of the unit operations; presentations of this study to a seminar group. Participation generally required each term of residence.

886. Selected Topics in Chemical Engineering
Fall, Winter, Spring, Summer, 3(3-0) CHE 446 or approval of department. May reenroll for a maximum of 9 credits if a different topic is taken. A newly developing area of chemical engineering selected by the department for offering in a given term. Information on the specific topic to be covered should be obtained from the department office before registration.

888. Research Survey
Fall, Winter, Spring, Summer. 1 to 3. May reenroll for a maximum of 3 credits. Literature search, problem analysis, and layout of a complete research program.

893. Special Problems
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

989. Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

912. Advanced Chemical Engineering Thermodynamics II
Spring of even-numbered years. 3(3-0) Approval of department. Relation of thermodynamics to quantum theory and statistical mechanics. Computation of chemical engineering thermodynamic data from spectral measurements. Irreversible thermodynamics.

916. Advanced Chemical Reaction Engineering II
Fall of odd-numbered years. 3(3-0) Approval of department. Quantitative treatment of current literature in chemical kinetics and reaction engineering.

927. Flow of Heat II
Fall of even-numbered years. 3(3-0) Approval of department. Fundamentals of radiant heat transfer. Computer techniques in the design of radiant and convective heat transfer equipment.

999. Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.