400H. Honors Work
Fall, Winter, Spring, Summer. 1 to 15 credits. Approval of department.
Independent and informal study in law, office administration or business communications.

416. Secretarial Administration III
Seminar
Winter, Spring. 4(4-0) Seniors or approval of department.
Analysis of the role of the executive secretary.

440. Law and Society
Fall, Winter, Spring, Summer. 3(3-0) Seniors or approval of department.
Legal reasoning and legal institutions. Court systems and court procedures. Relationships of citizen and businessman to governmental agencies. Tort, crimes.

441. Contracts and Sales
Fall, Winter, Spring, Summer. 3(3-0)
Contracts, including concept of freedom of contract and limitations. Sales. Case study method used.

442. Agency, Partnerships and Corporations
Winter. 3(3-0) 441.
The law dealing with agency and business organizations. Case study method used.

443. Negotiable Instruments, Secured Transactions, Property
Spring. 3(2-0) 441.
The law of negotiable instruments, secured transactions, and property. Case study method used.

445. Real Estate Law
Winter. 3(3-0) 341 or 441.

446. Interstate and International Business Law
Spring. 3(3-0) 341, 440 or 441.

447. Hotel Law
Fall, Winter. 3(3-0) 441.
Legal aspects of the hospitality industry.

457. Management of Insurance Enterprise
(AFA 457.) Spring. 3(4-0) 350 or approval of department.
Organizational requirements and functional operations of insurance enterprise with emphasis on methods of bookkeeping, reserves, financial statement and investment requirements, loss adjustment, underwriting, and marketing. Statutory limitations on management freedom.

458. The Legal Environment of Business
Winter, Summer. 4(4-0)
Critical examination of the environment in which business operates. Analysis of the component elements of the legal environment of business and the structural framework in which law functions.

460. Legal Environment of International Business
Spring, Summer. 4(4-0)
Commercial and financial transactions in international business, foreign agencies, branches, subsidiaries. Aspects of labor relations, antitrust, taxation, and transportation as related to foreign operations. Litigation and arbitration in the international business community.

471. Seminar: Office Administration
Winter, Summer. 3(3-0) May re-enroll for a maximum of 6 credits. Approval of department.
Problems, practices, and policies involved in office administration. Methods of establishing, analyzing, standardizing, and controlling administrative systems and procedures in the office.

475. Seminar in Business Law
Fall, Spring. 4(4-0) May re-enroll for a maximum of 8 credits. 845 or approval of department.
Public policy with regard to contracts, antitrust, security transactions, labor relations of the firm, viewed from the legislative, judicial, and executive vantage points.

484. Insurance Companies as Financial Institutions
(AFA 894.) Winter. 4(4-0)
Analysis of insurance company investment behavior in the capital market. Emphasis on liquidity requirements, interest rates, legal and organizational requirements affecting investment decisions. Micro and macro aspects are investigated.

486. Seminar in Insurance Problems
(AFA 856.) Spring. 4(4-0)
Analysis of insurance problems affecting the public interest. Special emphasis on problems due to changing economic and social conditions. Insurance regulatory, financial, marketing, and social problems are evaluated.

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

CHEMICAL ENGINEERING

College of Engineering

222. Pollution of the Environment—Causes and Cures
Spring. 3(3-0) Nominated; no science or technical background required.
Pollution of air, water and land. Adulteration of foods. Overtaxing of natural resources. Interaction of engineers, industry, government, and the public in creating and combating these problems.

300. Material and Energy Balances
(201.) Fall. 3(3-0) One year general chemistry, MTH 314.
Chemical engineering calculations. Material and energy balances in physical and chemical non-flow and flow systems. Behavior of ideal and real gas systems. Heats of reaction. Applications to chemical engineering systems.

311. Thermodynamics for Chemical Engineering
(202.) Winter. 3(3-0) 261.

312. Transfer Processes and Separations I
Winter. 3(3-0) 390, MTH 215.
Thermodynamics of fluid flow. Frictional effects for laminar and turbulent motion of compressible and incompressible fluids. Dimensional analyses and similarity. Treatment of fluid flow as a momentum transfer process.

313. Transfer Processes and Separations II
Spring. Winter. 3(3-0) 312.
Heat transfer in solids and flowing fluids. Heat transfer in condensing and boiling systems. Application to engineering equipment: Condensation, multiple effect evaporation, and radiation.

314. Transfer Processes and Separations III
Spring. 3(3-0) 311, 313 or concurrently.
Mass transfer in continuous contacting systems. Mass transfer in single-phase systems, transport analogies, interphase transfer and contacting of immiscible phases.

361. Chemical Thermodynamics
Fall, Spring. 3(4-0) One year general chemistry; one year general physics, MTH 215. Interdepartmental and jointly administered with the Chemistry Department.

415. Transfer Processes and Separations IV
Fall. 3(3-0) 314.

423. Chemical Engineering Laboratory
(422.) Winter. 3(1-6) 415.
Assigned laboratory problems, requiring team effort. Experimental work, involving momentum, heat and mass transfer, separation processes, such as distillation, filtration, and drying; reactor kinetics; automatic process control.
424. Transport Phenomena and Physical Properties Laboratory Spring, 3(3-0) 313 or concurrently. Experiments involving the transport processes and measurement of physical, chemical and thermodynamic properties of various materials. Comparison of theoretical and experimental results.

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


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


460. Problems and Reports Fall, Winter, Spring. 1 to 9 credits. Seniors, approval of department. Library and laboratory investigations of problems related to departmental research.

461. Process Selection and Optimization Winter. 3(3-0) 415. Application of chemical engineering principles in design calculations. Selection of the optimum design for equipment, functional units, and for the overall process. Influence of design on capital investment, operating cost, product loss, and product quality.

463. Process Design Spring, 3(3-0) 461. Integrated design of the complete chemical engineering process. Process engineering, project engineering, instrumentation, and layout.

465. Process Optimization Methods Fall, Spring, 3(3-0) MTH 215 or knowledge of linear algebra. Interdepartmental with Systems Science. Methods for determining optimum design and operating policies of systems of varying complexity. Includes classical methods, mathematical programming and modern methods.

470. Theory of Nuclear Reactors (381) Fall. 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 Fall, 3(3-0) 314, 361. 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 boundary layer theory.


511. Advanced Chemical Engineering Thermodynamics I Fall, 3(3-0) 311, 361, CEM 461. Advanced treatment of the laws of thermodynamics. Cervenog processes. Corresponding state and higher parameters in computing properties of chemical compounds and solutions.


525. Theory, Applicability and Engineering of Radioisotopes Winter of even-numbered years. 3(3-0) PHY 498 or CEM 461 or approval of department. Principles of utilization of radioisotopes in research and production problems for engineering and science majors. Fundamentals and preparation techniques of radioisotopes. Selection, specification, measurement and disposal for typical technical problems.

526. Flow of Heat I Spring, 3(3-0) 415. Steady and unsteady state heat transfer. Conduction and convection in flow and non-flow systems.

528. Optimisation of Static Nonlinear Systems Winter, Summer, 3(3-0) 465 or knowledge of linear programming. Interdepartmental with and administered by Systems Science. Problem formulation and classification, Kuhn-Tucker theory in nonlinear programming, gradient and search methods, techniques for quadratic, integer, geometric, and dynamic programming.


541. Advanced Transport Phenomena Winter. 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 interphase transport. Potential flow. Theories of turbulence from statistical standpoint.

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

581. Seminar Fall, Winter, Spring. Summer. 1(0-2) May re-enroll 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 technical developments in one of the unit operations; presentations of these studies to a seminar group. Participation generally required each term of residence.

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

588. Research Survey Fall, Winter, Spring. Summer. 1 to 3 credits. May re-enroll for a maximum of 3 credits. Literature search, problem analysis, and layout of a complete research project.

593. Special Problems Fall, Winter, Spring. Summer. Variable credits. Approval of department.

599. Research (EGR 899) 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.
Advanced Chemical Reaction Engineering II
Winter of even-numbered years. 3(3-0) Approval of department. Quantitative treatment of current literature in chemical kinetics and reaction engineering.

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.

Special Topics in Optimal chemical kinetics and reaction engineering. Approval

Fundamentals of radiant heat techniques in the design of radiant and convective heat transfer equipment.

Descriptions - Chemical Engineering of Courses

CHEMISTRY

College of Natural Science

Credit cannot be earned in more than one course of the following groups: 130 and 141, 131 and 141, 142 and 153, 132 and 241 or 351, 311 and 411, 383 and 461, 361 and 384, 394 and 472.

Introductory Chemistry I
Fall, Winter, Summer. 4(3-0) MTH 106 or 111 or concurrently. General discussion of principles. Atomic and molecular structure and spectra; stoichiometry; gases, liquids, solids, solutions, and changes of state. Laboratory experiments via film, TV tape or live demonstration.

Introductory Chemistry II
Winter, Spring, Summer. 3(3-0) 130; 161 concurrently. Continuation of 130. Chemical kinetics and equilibrium; ionic equilibrium; solids and bases.

Introductory Chemistry: Carbon Compounds
Fall, Spring. 3(3-2) 131 or 141 or concurrently. Chemistry of carbon compounds, introducing the aliphatic and aromatic hydrocarbons. Some typical compounds are prepared and their behavior studied.

Principles of Chemistry I
Fall, Winter. 4(4-0) MTH 106 or 111 or concurrently; satisfactory grade on placement examination; 161 concurrently. Atomic and molecular structure, chemical kinetics and equilibrium; solids and bases. The solid state.

Principles of Chemistry III
Fall, Spring. 3(3-0) 131 or 141. Reactions and behavior of inorganic compounds.

Principles of Chemistry II
Fall, Winter, Spring. 3(3-0) 131 or 141; MTH 112 or concurrently. Grade of C or better in 131 or 141 recommended. Thermochromy and applications of thermochromic principles; equilibrium and electron chemistry.

Introductory Inorganic Chemistry
Fall, Spring. 3(3-0) 152. Descriptive inorganic chemistry with further discussion of bonding; introduction to radiochemistry.

Introductory Chemistry Laboratory
Fall, Winter, Spring, Summer. 1(0-3) 131 or 141 concurrently. Laboratory work in chemistry including quantitative physical or analytical experiments and chemical synthesis.

Quantitative Analysis
Fall, Winter, Spring, Summer. 2(0-6) 131 or 141; 161. Laboratory work in quantitative chemistry.

Introductory Inorganic Laboratory
Spring, 2(0-6) 168. Qualitative analysis and inorganic preparations.

Organic Chemistry
Fall, Winter, Summer. 4(4-0) 131 or 141; 161. Common classes of organic compounds with emphasis on nomenclature, structural principles, reactions and reaction mechanisms.

Organic Chemistry Laboratory
Fall, Winter, Spring. 2(0-6) 241 or concurrently. Introduction to standard organic laboratory techniques.

Organic Chemistry Laboratory
Winter, Spring, Summer. 1(0-3) 241. Organic preparations and qualitative analysis.

Organic Chemistry
Spring. 3(3-0) 242. Special topics in organic chemistry. Reactions of technical and biological interest, stereochemistry, reaction mechanism, etc.

Inorganic Chemistry
Fall, Summer. 4(4-0) 384 or 461 or concurrently; approval of department. The chemistry of selected non-metals and metals. Elementary coordination chemistry and acid-base theory. Bonding in inorganic compounds. The periodic law and table.

Instrumental Methods
Spring. 4(2-8) 132 or 241 or 351; 162. Principles, applications of separation and instrumental analysis. Atomic emission, absorption, fluorescence, spectrophotometry; UV, visible, IR spectrophotometry; molecular fluorescence; gas and other chromatography; electroanalytical chemistry; electrophoresis; radiocmetry.

Organic Chemistry Laboratory I
Winter. 2(1-3) 162; 383 or 381. Measurement techniques. Temperature measurement and control, pressure, calorimetry, pH, acid-base titrations, cell potentials, treatment of data.

Analytical-Physical Chemistry I
Spring. 3(4-0) 361. Applications of thermodynamics. Activity coefficients, ionic solutions, cell potentials, ion-exchanger including acid-base complexation, solubility and redox equilibria, phase equilibria, distillation, extraction, chromatography.

Analytical-Physical Chemistry II
Spring. 3(4-0) 362. Chemical kinetics. Homogeneous reactions, reaction mechanisms, temperature dependence of reaction rates, transport process, heterogeneous kinetics, electrode kinetics, X-ray diffraction, crystal structure.

Analytical-Physical Chemistry Laboratory I
Spring. 2(1-3) 370. Instrumental measurements, Electrochemical, spectroscopy, spectrophotometry, electrolytic conductance, solution kinetics.

Physical Chemistry: Introductory
Fall, Summer. 3(4-0) 132 or 241 or 351; MTH 113. Classical and chemical thermodynamics. Introduction to the laws and their applications in treating chemical reactions, pure substances, ideal and non-ideal mixtures, and colligative properties.

Organi...