

890. Selected Topics in Plant Pathology
Fall, Winter, Spring. 2 to 5 credits.
Approval of department.

Topics will be selected from the following areas: parasitism, plant viruses, ecology, genetics, nematology, fungicidal action, and soil microbiology.

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

Research for thesis at the master's degree level in one of the following fields: anatomy, cytology, ecology, genetics, lichenology, morphology, mycology, pathology, phycology, physiology, and taxonomy.

918. Advanced Genetics
Winter of odd-numbered years. 3(3-0)
Approval of department.

Role of the gene in differentiation and development, with special emphasis upon the genetic mechanisms responsible for the control of phenogenesis.

919. Cytogenetics
Fall. 3(3-0) 918.

920. Advanced Plant Taxonomy
Spring of even-numbered years. 4(4-0)
824, ZOL 441.

Consideration of the recent scientific developments affecting plant classification.

930. Advanced Plant Ecology
Spring of odd-numbered years. 3(2-4)
415, 450, 824.

Fundamental theories and modern research horizons.

951. Advanced Plant Physiology I
(943.) Fall of even-numbered years.
3(3-0) Approval of department.

Selected topics concerning absorption and inorganic nutrition.

952. Plant Physiology and Biochemistry I
(944.) Winter of odd-numbered years.

3(3-0) Approval of department. Interdepartmental with and administered by the Biochemistry Department.

Selected topics concerning photosynthesis and related processes.

953. Advanced Plant Physiology II
(945.) Spring of odd-numbered years.

3(3-0) Approval of department.
Selected topics concerning the chemistry, physiology and mechanism of action of plant growth hormones.

954. Advanced Plant Physiology III
(946.) Fall of odd-numbered years.

3(3-0) Approval of department.

Selected topics from environmental physiology.

955. Plant Physiology and Biochemistry II
(947.) Winter of even-numbered years.

3(3-0) Approval of department. Interdepartmental with and administered by the Biochemistry Department.

Metabolic pathways of unique significance to plants.

956. Advanced Plant Physiology IV
(948.) Spring of even-numbered years.

3(3-0) Approval of department.
Factors influencing vegetative and reproductive physiology.

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

Research for thesis at the doctor's degree level in one of the following fields: anatomy, cytology, ecology, genetics, lichenology, morphology, mycology, paleobotany, pathology, phycology, physiology, and taxonomy.

BUILDING CONSTRUCTION

See Packaging

BUSINESS LAW AND OFFICE ADMINISTRATION BOA

College of Business

201. Shorthand I
Fall, Winter, Spring, Summer. 3(4-0)
234 or 1 term typewriting.

Gregg shorthand theory, dictation and transcription for students with no previous training.

202. Shorthand II
Fall, Winter, Spring, Summer. 3(3-1)
201, 234 or 1 term shorthand and typewriting.

Development of theory and transcription competency, speed building.

203. Shorthand III
Fall, Winter, Spring. 3(3-1) 202,
235.

Continuation of 202.

204. Advanced Shorthand
Fall, Winter, Spring. 3(3-1) 203,
236.

Continuation of 203.

234. Typewriting I
Fall, Winter, Spring, Summer. 2(2-2)
Approval of department.

Mastery of keyboard; building speed and accuracy; elementary typewriting problems.

235. Typewriting II
Fall, Winter, Spring. 2(2-2) 234 or
approval of department.

Improvement of speed and accuracy; arrangement of business letters, tabulation and manuscripts; production typewriting.

236. Advanced Typewriting
Fall, Winter, Spring, Summer. 3(3-1)
235 or 1½ to 2 years typewriting.

Instruction in specialized typewriting problems to develop high-level competency.

308. Secretarial Administration I
Fall, Winter, Spring. 4(4-0) 204,
236. Sophomores.

Development of proficiency in transcription skills.

309. Secretarial Administration II
Fall, Winter, Spring. 4(4-2) 236,
Sophomores.

Machine dictation-transcription; duplication and copying processes; machine calculations; records management.

326. Business Writing
Fall, Winter, Spring, Summer. 4(4-0)
Juniors.

Study and analysis of business and industrial communication problems; extensive instruction and practice in writing.

326H. Writing in a Business Culture
Fall, Winter. 4(4-0) Honors College
students.

This intensive honors course in business writing ranges from letters to review articles on professional journals. Historical and linguistic study to illuminate business and technological culture.

341. Survey of Business Law
Fall, Winter, Spring, Summer. 4(4-0)
Juniors. Not open to business administration
students.

Historical development of the law; courts, court procedures and civil remedies, torts, crimes; contracts, agency, sales, negotiable instruments, real and personal property, including bailments and liens. Textbook and lecture rather than case approach.

370. Office Administration
Fall, Winter, Spring, Summer. 3(3-0)
Juniors.

Analysis of office function and relationship to business organization; information handling and data processing; office design and layout; responsibilities of office administrators.

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.

427. Business and Technical Reports
Fall, Spring. 4(4-0) Juniors

Discussion and illustration of report writing techniques; study of use, form, and structure of different types; practice in preparing the most frequently used. One complete research report required.

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. Torts, crimes.

441. Law of Contracts and Business Organizations
Fall, Winter, Spring, Summer. 5(5-0)
440.

Law of contracts, including the concept of freedom of contract and its importance as the focal point of business transactions. Study of the legal framework within which formal business organizations must operate.

443. Property, Sales, Negotiable Instruments
Spring. 4(4-0) 441.

Law of real and personal property, including bailments, liens and security transactions, sales, and negotiable instruments. Case study method used.

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

Law of real and personal property, including fixtures, easements, land descriptions, titles, deeds, recording requirements, brokers, land contracts, escrows, closing of sale, abstracts, mortgages, mechanics liens, co-ownership, descent and distribution, administration of estates, zoning, taxes, landlord and tenant. Combined text and case approach.

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

Laws of contracts, sales, negotiable instruments, agency, business associations in the interstate and international spheres. Maritime contracts. International commercial arbitration. Area directed studies.

447. Hotel Law
Winter, Spring. 4(4-0) 440.
Negotiable instruments, warranties, property, torts, civil rights, agency, partnerships, corporations as applied to hotel and restaurant management.

468. Field Studies
Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 8 credits. Business majors and approval of department.

Planned program of observation and work in selected business firms. Analysis and reports.

848. 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.

849. 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, anti-trust, taxation, and transportation as related to foreign operations. Litigation and arbitration in the international business community.

871. Seminar: Office Management
Winter, Summer. 3 credits. 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.

878. Seminar in Business Law
Fall, Spring. 4(4-0) May re-enroll for a maximum of 8 credits. 848 or approval of department.

Public policy with regard to contracts, anti-trust, security transactions, labor relations of the firm, viewed from the legislative, judicial, and executive vantage points.

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

CHEMICAL ENGINEERING CHE

College of Engineering

201. Chemical Engineering Calculations
Fall, Winter. 3(3-0) CEM 153; MTH 214; PHY 287 or concurrently.

Chemical engineering calculations. Organization of calculations. Material balances, energy balances, behavior of gases, equilibrium relations and reaction rates.

202. Thermodynamics for Chemical Engineering
Winter, Spring. 3(3-0) 201, MTH 215 or concurrently.

First and second laws. Internal energy, enthalpy, entropy, free energy, and work functions. Application to batch and flow processes, open and closed systems, reacting and nonreacting systems. Interrelationships of thermodynamic properties for perfect gases and for real substances.

301. Transfer Processes and Separations
Fall, Winter. 4(4-0) 201; 361 or concurrently; MTH 215.

Thermodynamics of fluid flow. Application to flow equipment. Frictional effects for laminar and turbulent motion of compressible and incompressible fluids. Dimensional analysis and similitude. Continuity and flow equations in tensor notation. Treatment of fluid flow as a momentum transfer process. Analogous treatment of heat flow. Heat transfer in solids and flowing fluids.

302. Transfer Processes and Separations
Winter, Spring. 4(4-0) 301.

Heat transfer in condensing and boiling systems. Application to engineering equipment. Condensers, interchangers, and multiple effect evaporators. Radiation. Mass transfer. Analogies with momentum and heat. Continuous and stagewise contactors.

303. Transfer Processes and Separations
Fall, Spring. 4(4-0) 302.

Simultaneous heat and mass transfer. Humidification. Gas absorption. Distillation, ideal, non-ideal, binary and multicomponent. Extraction. Azeotropic and extractive distillation. Mass transfer with chemical reaction.

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.

Thermodynamics. Properties of gases. Laws of thermodynamics, properties of ideal and non-ideal solutions, thermodynamics of chemical reactions, activities in non-ionic systems.

404. Chemical Engineering Operations
Spring. 3(3-0) 303 or concurrently.

Mechanical separation of heterogeneous mixtures. Gravitational and centrifugal methods. Cake filtration and filter-medium filtration. Crystallization from solution. Phase equilibria and separation by crystallization. Adsorption and chromatography.

422. Chemical Engineering Laboratory
Fall, Winter. 4(0-12) 303.

Assigned projects requiring laboratory investigation. Experimental work involving transport phenomena, momentum, heat, and mass transfer; separation processes such as distillation, filtration, and drying; thermodynamics and reactor kinetics.

428. Chemical Reaction Engineering
Fall. 3(3-0) 303; CEM 362, 461.

Quantitative treatment of mechanisms and rates of chemical reactions. Catalysis. Design and analysis of flow and non-flow reactors. Interpretation of laboratory kinetic data.

443. Chemical Engineering of the Solid State
Spring. 4(4-0) CEM 461.

Polymeric, crystalline, organic, and inorganic solids. Relation of bond type and steric configuration to mechanical, electrical, thermal, and optical properties. Influence of macroscopic structure on physical properties. Surface phenomena. Applications.

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.

451. Dynamics and Control of Chemical Engineering Systems
Winter. 5(5-0) 303, MTH 215.

Transient behavior of chemical engineering processes. Elements and dynamic response of control loops. Composition measurement and control. Analysis of system stability. Optimizing control.

460. Problems and Reports
Fall, Winter, Spring. 1 to 9 credits. Seniors, approval of department.

Library and laboratory investigations of problems relating to departmental research.

461. Process Selection and Optimization
Winter. 3(3-0) 303.

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.

462. Process Design
Spring. 3(1-6) 461.

Integrated design of the complete chemical engineering process. Process engineering, project engineering, instrumentation, and layout.

465. Process Optimization Methods
Spring. 3(3-0) MTH 215, 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.

481. Transport Phenomena
Fall. 3(3-0) 303, 361.

Solution of engineering problems using the general equations of change for transport of momentum, heat, and mass in an arbitrary continuum. Interphase transport.

801. Advanced Chemical Engineering Calculations I
Fall. 3(3-0) 303.

Chemical engineering applications of advanced mathematical methods. Formulation and solution of mathematical equations which describe physical problems. Computer solutions.

802. Advanced Chemical Engineering Calculations II
Winter. 3(3-0) 801.

Continuation of 801.

811. Advanced Chemical Engineering Thermodynamics I
Fall. 3(3-0) 203, 361; CEM 461.

Advanced treatment of the laws of thermodynamics. Cryogenic processes. Corresponding state and higher parameters in computing properties of chemical compounds and solutions.

817. Advanced Chemical Reaction Engineering I
Winter. 3(3-0) 428.

Treatment of absorption and catalysis and their application to catalytic reactors. Heat, momentum, and mass-transfer in fixed-bed and fluidized-bed reactors. Non-catalytic heterogeneous reactions. Homogenous chain reactions and free radical mechanisms. Computer applications to solution of complex kinetic problems.

821. Theory of Nuclear Reactors
Fall of even-numbered years. 3(3-0) PHY 289; MTH 341; or approval of department.

Theory and design of nuclear research and power reactors. Nuclear transformation, fission, and energy conversion. Derivation of chain