601. Osteopathic Manipulative Medicine Clerkship

Fall, Winter, Spring, Summer. 6 credits. May reenroll for a maximum of 12 credits. Grade P in all courses offered in terms 1 through 8.

Advanced training in the diagnosis of musculoskeletal dysfunctions and application of osteopathic manipulative techniques in patient care.

620. Directed Studies

Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 24 credits. Approval of department.

Individual or group work on special problems related to biomechanics, neuromusculoskeletal system primarily.

800. Special Topics

Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 9 credits. Approval of department.

Independent study in topics of biomechanics.

810. Biokinematics

Fall. 3(3-0) Approval of department.

Motion of the human body including detailed studies of body joint and linkage motion.

811. Biokinetics

Winter. 3(3-0) BIM 810.

Application of Newtonian mechanics to problems of force transmission and related motions in the muscular-skeletal system.

812. Theory of Tissue Mechanics

Spring. 3(3-0) Approval of department.

Introduces the concepts of stress and strain in tissue and the dependency of mechanical parameters on biological factors.

850. Research Seminar

Fall, Winter, Spring. 1(1-0) May reenroll for a maximum of 3 credits. Approval of department.

Discussion of current research topics in biomechanics with strong clinical application.

890. Independent Study

Fall, Winter, Spring, Summer. 1 to 8 credits. May reenroll for a maximum of 32 credits. Approval of department.

Individual or group work related to biomechanics and/or neuromusculoskeletal system.

899. Master's Thesis Research

Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 12 credits. Approval of department.

Conduct research for master's thesis.

BIOMEDICAL ENGINEERING BME

College of Engineering

410. Electronic Instrumentation in Biology and Medicine

Fall. 4(4-0) MTH 112, PHY 238 or approval of instructor.

Electronic components and circuits. Physiological measurements. Transduction of physiological events to electrical signals. Detection of physiological events by electrical impedance measurements. Ultrasonic techniques in biomedical systems. Biomedical applications of lasers.

411. Electric Theory of Nerves

Winter of odd-numbered years. 4(4-0) MTH 310; PHY 288.

Neurophysiology: basic organization, structure, function and electrical activity of neurons. Subthreshold membrane phenomena: Nernst-Planck equations, constant field membrane model, electrotonus. Membrane action potentials: voltage clamp experiments, Hodgkin-Huxley equations, computer simulation.

414. Clinical Instrumentation

Winter of even-numbered years. 3(3-0) BME 410.

Ultrasound theory and applications in medicine. Photoelectric, piezoelectric and temperature transducers. Detection of physiological events by impedance measurements. Radiology and x-ray techniques. Isotopes and nuclear medicine. Lasers in medicine. Field trips required.

424. Materials in Biomedical Engineering

Winter. 3(3-0) PSL 240 or PSL 431 or approval of department.

Basics of materials science. Biocompatibility of metals, polymers and ceramics. Internal and external prosthetic materials.

431. Biological Transport Mechanisms

Spring. 3(3-0) MTH 215.

Mechanisms which govern transport or momentum, heat and mass. Application to mathematical description of transport processes in biological systems and to solution of biomedical problems.

481. Tissue Biomechanics

Fall. 3(3-0) ANT 316 or approval of department.

Fundamentals of continuum mechanics in relation to morphological classification of tissue. Mechanical properties of connective and muscle tissue.

499. Independent Study

Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 9 credits. Approval of instructor.

Individual reading and research under the supervision of a member of the Biomedical Engineering Committee.

BOTANY AND PLANT PATHOLOGY BOT

College of Agriculture and Natural Resources
College of Natural Science

201. Plants, People and the Environment (N)

Fall, Spring. 3(3-0)

Relevance of plants to modern society. Basic botanical concepts and socially significant groups of plants. Natural resource exploitation. Plants as they relate to human population growth, food production, and energy resource depletion.

205. Plant Biology

Fall. 3(3-0) High school chemistry and high school algebra.

An introduction to plant science for students seeking a general knowledge of the principles of plant biology as well as for prospective plant science majors.

206. Plant Biology Laboratory

Fall. 1(0-3) BOT 205 or concurrently.

Physiological experiments and hands-on study of plant diversity at the cellular, tissue and whole plant level.

301. Introductory Plant Physiology

Winter, Spring. 4(2-4) CEM 141A or CEM 151; CEM 161; BOT 205 or B S 210 or LBS 141. Introductory organic chemistry recommended.

General principles of plant physiology relating plant structure to function. Topics include cell physiology, water relations, effects of light and temperature, respiration, photosynthesis, mineral nutrition, and hormone action.

302. Introductory Morphology

Winter. 4(2-4) BOT 205 or B S 212 or approval of department.

Structures and life cycles of representative plant groups showing progressive evolutionary developments.

318. Introductory Plant Systematics

Spring. 4(3-3) BOT 302 or B S 212 or approval of department.

Plant diversity with emphasis on identification, classification, nomenclature, and evolutionary relationships of vascular plants.

330. Forest Protection

Fall. 4(4-0) FOR 304, FOR 305, FOR 320. Interdepartmental with the departments of Entomology and Forestry. Administered by the Department of Forestry.

Procedures used to detect and respond to pest, fire and environmental problems in a variety of forest types.

335. Fossil Plants, Their History and Paleoecology

Spring. 3(3-0) One course in geology or botany or biology or approval of department. Interdepartmental with and administered by the Department of Geology.

History of plants through geologic time; their form and evolution; how and where found, identified and reconstructed; their use in determining ancient geographic patterns, paleoenvironments, paleoclimates and community structure. Field trip.

336. Economic Plants

Winter. 3(3-0) BOT 205 or B S 212 or approval of department.

Plants used by humans viewed from economic, historical, cultural, and botanical perspectives. Emphasis on food, fiber and medicinal plants. Includes plants used for herbs, dyes, perfumes, alchohol, stimulants, ornamentals, energy.

400. Aquatic Plants

Fall. 3(2-3) BOT 318 or BOT 302. Students may not receive credit in both BOT 400 and BOT 423.

Aquatic plants, their classification, ecology and economic importance. Relationships to problems in fisheries, in wildlife management, and to role in limnology. Experience for student in plant ecology, aquatic biology, and water sanitation.

400H. Honors Work

Fall, Winter, Spring. 3(0-6) Approval of department; Seniors.

401. Directed Studies

Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 16 credits. Approval of instructor.

Directed research or study of published literature. Areas of study include (but are not limited to) plant morphology, taxonomy, anatomy, ecology, paleobotany, cell biology, genetics, mycology, physiology, and various areas of plant pathology.

402. Introductory Mycology

Fall. 4(2-6) B S 212 or LBS 140 or approval of department.

Survey of the fungi including characteristics, habits and diversity. Background course for biology students or those expecting to specialize in microbiology, mycology, plant pathology, or other fields involving fungi.

403. Elements of Cell Function and Structure

Spring. 4(4-0) MPH 407, BCH 453 concurrently. Interdepartmental with the Department of Microbiology and Public Health. Administered by the Department of Microbiology and Public Health.

Cell biology of eukaryotic cells, with an emphasis on the molecular mechanisms that underlie cellular processes.

405. Introductory Plant Pathology

Fall. 4(2-4) BOT 302 or B S 212 or approval of department. Students may not receive credit in both BOT 405 and BOT 407.

General principles of plant pathology including detailed study of selected diseases as examples of important groups.

406. Medical Mycology

Fall, Spring. 4(2-6) BOT 402 or approval of department. Interdepartmental with the Department of Microbiology and Public Health.

Characteristics, habits, and laboratory identification of fungus diseases infecting humans. Emphasis on laboratory techniques and morphological characteristics of the various mycoses.

407. Diseases of Forest and Shade Trees

Spring. 4(3-2) BOT 301; BOT 302; BOT 318 or FOR 204. Students may not receive credit in both BOT 405 and BOT 407.

Diseases which affect trees in forests, parks, suburbs and nurseries, and methods of control.

409. Plant Disease Control

Winter of odd-numbered years. 3(3-0) BOT 405.

Principals and methods in controlling plant diseases. Considerable emphasis is placed on the chemistry of fungicides, and their role in controlling plant diseases. Other factors affecting disease epidemiology are covered.

411. Systematic Botany

Summer. 4(2-6). B S 212, BOT 302 or approval of department. Students may not receive credit in both BOT 411 and BOT 425.

Taxonomy, identification, and evolutionary relationships of vascular plants, illustrated by the local flora; extensive field studies.

413. Environmental Plant Physiology

Winter. 3(3-0) B S 210 or LBS 141 or BOT 205.

Major topics include plant-soil-water relationships, gas exchange, and stress physiology. Minor topics include mineral nutrition and energy budgets.

414. Plant Physiology: Metabolism

Fall. 5(3-4) CEM 241; B S 210 or LBS 141 or BOT 205; BOT 301.

General principles underlying plant metabolic processes. Nutrient requirements, photosynthesis, translocation, respiration, nitrogen metabolism, and structures associated with these processes.

415. Plant Physiology: Growth and Development

Spring. Summer of even-numbered years. 5(3-4) BOT 414 or approval of department.

Growth and development in plants. Topics include the chemistry and effects of hormones, tropisms, thermoperiodicity, reproduction, vernalization and photoperiodism, photomorphogenesis, dormancy, and biological clocks.

423. Aquatic and Wetland Plants

Summer. 3 credits. Students may not receive credit in both BOT 423 and BOT 400. BOT 302, B S 212 or approval of department. Given at W. K. Kellogg Biological Station.

Extensive exposure to plants in aquatic environments. Emphasis on systematics, morphology, evolution and community relations. Survey of diverse wetland and aquatic habitats with numerous field trips.

425. Field Plant Systematics

Summer. 4 credits. B S 212 or approval of department. Students may not receive credit in both BOT 425 and BOT 411. Given at W. K. Kellogg Biological Station.

Classification, evolution, distribution and biology of vascular plants. Emphasis on field recognition, indentification. Numerous field trips to diverse habitats for common, rare, native and introduced plants.

427. Cell Biology

Fall. 4(4-0) BCH 200 and one year of general botany or general zoology.

Organization and structure of the cell, with emphasis on eukaryotes. Structure and function of the nucleus and cytoplasmic organelles. An introduction to molecular biology.

434. Plant Anatomy

Fall. 4(2-4) B S 212 or BOT 205.

Principles underlying the differentiation and growth of vegetative plant structures with special emphasis upon their functional and developmental genetic relationships.

441. Geographical Plant Ecology

Winter. 3(3-0) BOT 205 or BOT 302 or B S 212 or approval of department.

Distribution and ecology of plants and plant communities in Polar, temperate and tropical regions with emphasis on North America. Geological history and environmental factors which influence distribution. Island biogeography.

447. Fresh Water Algae

Spring: 4(2-4). Given at W. K. Kellogg Biological Station Summer term: 4 credits. B S 212, BOT 302. Students may not receive credit in both BOT 421 and BOT 447.

Identification of fresh water algae, especially those forms concerned with fish food problems, water contamination and limnology. Methods for making analyses of samples for biological survey work on lakes and streams. Economic aspects and life histories of the algae.

450. Ecology

Spring: 4(2-4). Given at W. K. Kellogg Biological Station Summer term: 4 credits. BOT 318; BOT 301 or BOT 414.

Interrelationship of plants and environment. Factors which govern their distribution.

464. Comparative Limnology

Summer. 6 credits. B S 212. Given at W. K. Kellogg Biological Station. Interdepartmental with and administered by the Department of Zoology.

Theoretical concepts and methods of analysis of environmental parameters influencing productivity of freshwaters. Comparative field investigations of lakes, streams, and other aquatic habitats.

470. Nematode Diseases of Economic Plants

Spring of odd-numbered years. 4(3-3) BOT 405. Interdepartmental with and administered by the Department of Entomology.

Major nematode diseases of economically important plants, with emphasis on diagnostic symptoms, nematode biology and principles of control.

490. Special Topics in Plant Pathology

Fall, Winter, Spring. 2 to 5 credits. May reenroll for a maximum of 6 credits if different topics are taken. Approval of department.

Topics may be selected from the following areas: genetics, parasitism, virology, disease control, phytobacteriology, nematology, epidemiology, physiology, soil microbiology, and others.

499. Senior Seminar

Winter. 1(1-0) May reenroll for a maximum of 3 credits. B S 212 and 1 course in botany or approval of department.

Reports by students, faculty, and guest lecturers, with emphasis on current developments in research.

800. Special Problems in Taxonomy

Fall, Winter, Spring. 1 to 15 credits. Approval of department.

801. Special Problems in Anatomy and Morphology

Fall, Winter, Spring. 1 to 15 credits. Approval of department.

802. Special Problems in Pathology

Fall, Winter, Spring, Summer. 1 to 15 credits. Approval of department.

803. Special Problems in Physiology

Fall, Winter, Spring, Summer. 1 to 15 credits. Approval of department.

805. Special Problems in Mycology

Fall, Winter, Spring, Summer. 1 to 15 credits. Approval of department.

807. Special Problems in Algae

Fall, Winter, Spring, Summer. 1 to 15 credits. Approval of department.

809. Special Problems in Ecology

Fall, Winter, Spring, Summer. 1 to 15 credits. Approval of department.

812. Ecology of Plant Pathogens

Winter of even-numbered years. 3(3-0) BOT 402, BOT 405; or approval of department.

Ecology and qualitative epidemiology of plant pathogens. Problems confronting pathogens in their environment and strategies for survival. Inoculum dispersal, inoculum potential, seasonal carry-over, influence of host exudates, influence of microbiota.

813. Special Problems

Fall, Winter, Spring. 1 to 4 credits. May reenroll for a maximum of 16 credits. Approval of department.

816. Industrial Mycology

Winter of odd-numbered years. 3(2-4) BOT 402 or approval of department.

Industrially important fungi, their uses and characteristics. Methods of commercial production, including acids, enzymes, cheeses, mushrooms, and antibiotics. Several field trips will be taken.

821. Ecology of Algae and Aquatic Plants

Summer of odd-numbered years. 6 credits. BOT 400, BOT 447 or approval of department. Given at the W. K. Kellogg Biological Station.

Physiology and ecology of freshwater phytoplankton, sessile algae, and aquatic plants. Emphasis on physiological adaptations, mineral nutrition, growth, population dynamics, community productivity, and control measures.

823. Plant Taxonomy I

Fall of odd-numbered years. 4(3-3) BOT 318; ZOL 441 recommended.

First course of a series on classification and relationships of vascular plants. Family characteristics, patterns, geographic distribution, and evolutionary trends are stressed. Contributions from classical taxonomy, cytotaxonomy and experimental taxonomy are discussed.

824. Plant Taxonomy II

Winter of even-numbered years. 4(3-3) BOT 823.

Second course of a series on classification and relationships of vascular plants.

830. Paleobotany

Fall. 4(3-4) Approval of department. Interdepartmental with Geology.

Survey of fossil plants: their preservation, occurrence, geology, paleogeography, paleoecology, evolutionary history, classification and representative types. One weekend field trip to fossil plant locality.

831. Palynology

Spring. 4(3-4) Approval of department. Interdepartmental with and administered by the Department of Geology.

An introduction to the principles and techniques of spore and pollen analysis, both fossil and recent, and utilization of plant micro-fossils for stratigraphic determinations and paleoecologic interpretations of most sedimentary accumulations and rocks. Includes certain algae, protozoans, similar organisms of uncertain affinity and dissociated fragments of larger organisms.

836. Advanced Mycology: Biology of the Phycomycetes

Spring of even-numbered years. 3(3-0) BOT 402 and approval of department.

Selected topics on the biology of phycomycetous fungi.

838. Advanced Paleobotany

Winter. 3(2-4) Approval of department. Interdepartmental with Geology.

Morphology, anatomy, phylogenetic relationships and classification of fossil plants. Microscopic analysis of tissues and organs prepared by thin section, transfers, peels, polished and etched surfaces, and macerations.

839. Population Ecology

Summer of odd-numbered years. 3 credits. May reenroll for a maximum of 6 credits. Approval of department. Given at W. K. Kellogg Biological Station. Interdepartmental with and administered by the Department of Zoology.

A field-experimental approach to the study of adaptations. Selected topics will deal with population growth, competition, predation, mutation, community structure and species abundance.

842. Chromosome Structure and Genetics

Winter of even-numbered years. 4(4-0) Introductory genetics course. Interdepartmental with Genetics and the department of Zoology. Administered by Genetics.

Mechanisms of mitosis and meiosis, classical and molecular genetics of chromosome structure, alterations in chromosome number and structure, transposable elements, meiotic drive.

844. Plant Organelle Genetics

(HRT 844.) Winter of odd-numbered years. 3(3-0) Approval of department. Interdepartmental with Genetics.

Organization, structure, function, heredity, molecular biology and manipulation of chloroplasts and mitochondria. Biological interactions between the nucleus and organelles.

846. Seminar in Plant Pathology

Fall, Winter, Spring. 1(1-0) Approval of department.

850. Agrostology

Fall of even-numbered years. 3(1-4) One year of botany or approval of department.

Comprehensive treatment of the systematics, evolution, ecology, geography and economic significance of the grass family; including pertinent aspects of genetics, cytology, anatomy and physiology.

852. Plant Population Ecology

Fall of odd-numbered years. 4(4-0) BOT 450 or ZOL 389, STT 422, 1 term of calculus.

The dynamics, evolution, regulation, and distribution of plant populations; subject matter interfaces with plant genetics, plant systematics, and plant physiology.

856. Plant Genetics and Molecular Biology

Spring of even-numbered years. 3(3-0) Approval of department and a course in introductory genetics. Interdepartmental with Genetics and the Department of Biochemistry.

Recent advances in genetics and molecular biology of higher plants.

863. Advanced Environmental Physiology

Winter. 3(3-0) BOT 413 or approval of department.

The plant in relation to its environment: energy exchange; coupling between CO_2 assimilation and transpiration; hydraulics in the stationary and nonstationary states; transport of ions, carbohydrates, and hormones; stress physiology.

864. Plant Biochemistry

Spring. 4(4-0) BCH 401, BOT 301 or approval of department. Interdepartmental with and administered by the Department of Biochemistry.

Metabolism of nitrogen-compounds, carbohydrates, and lipids unique to plants' cell organelles; photosynthesis; photorespiration; dark respiration; cell walls; lectins; nitrogen cycle including nitrogen fixation; sulfur cycle.

865. Advanced Growth and Development

Fall. 3(3-0) BOT 415 or approval of department.

Advanced treatment of the physiological processes of growth and development. The mechanism underlying these processes and the roles played by hormones, light, etc., in controlling them will be analyzed.

871. Biology of Nematodes

Spring of even-numbered years. 4(2-6) ENT 470 or approval of department. Interdepartmental with and administered by the Department of Entomology.

Ontogeny, taxonomy, morphology, pathology and ecology of nematodes, with special reference to plant-parasitic and phytopathogenic species.

880. Plant Virology

Fall of odd-numbered years. 5(2-6) BOT 405 or approval of department.

External and internal symptomatology, transmission, interactions, purifications, assay and serology of plant viruses.

881. Pathogenesis and Disease Resistance

Winter of odd-numbered years. 4(3-2) BOT 405 and BOT 415, or approval of department.

Lectures, readings, and discussions on mechanisms of pathogenicity and infectivity; physiology and biochemistry of disease development; tumorigenesis; metabolic consequences of infection; nature of disease resistance; and parasitism.

884. Phytobacteriology

Spring of odd-numbered years. 5(3-4) BOT 405 or approval of instructor.

Bacterial genera associated with plant diseases. Their description, identification, physiology, and genetics. Emphasis on laboratory techniques.

885. Plant Diseases in the Field

Spring. 4 credits. BOT 405 and approval of department.

Diagnosis, distribution, and sequential development of plant diseases in the field. Field trips permit observation of diseases in the natural setting.

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.

891. Selected Topics in Botany

Fall, Winter, Spring. 2 to 5 credits. May reenroll for a maximum of 6 credits if different topics are taken. Approval of department.

Topics may be selected from ecology, systematics, evolution, physiology, cytology, mycology, bryology, phycology, lichenology, anatomy, morphology, genetics, and others.

899. Master's Thesis Research

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

Research in anatomy, bryology, cytology, ecology, genetics, lichenology, morphology, mycology, paleobotany, pathology, phycology, physiology, and taxonomy.

930. Advanced Plant Ecology

Winter of odd-numbered years; Summer of even-numbered years. Given at W. K. Kellogg Biological Station summer term. 3(2-4) Approval of department.

Fundamental theories and modern research horizons.

999. Doctoral Dissertation Research

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

Research in anatomy, bryology, cytology, ecology, genetics, lichenology, morphology, mycology, paleobotany, pathology, phycology, physiology, and taxonomy.

BUILDING CONSTRUCTION MANAGEMENT

See Agricultural Engineering.

CHEMICAL ENGINEERING CHE

College of Engineering

300. Material and Energy Balances

Fall, Winter. 4(3-2) One year general chemistry, MTH 214 or concurrently, CPS 112 or concurrently.

Chemical engineering calculations. Synthesis of chemical process systems. Analysis of chemical process systems by material and energy balances. Behavior of gases. Enthalpy calculations for changes of temperature, phase changes, chemical reactions.

311. Thermodynamics for Chemical Engineering

Winter, Spring. 3(3-0) CHE 300 or approval of department.

First and second laws. Energy, enthalpy, entrophy, free energy, the mathematics of property relationships. Energy conversion processes. Thermodynamics of flow.

340. Transfer Processes and Separations I

Fall. 3(2-2) CHE 300 or concurrently, CHE 381 or concurrently or approval of department.

Thermodynamics of fluid flow. Treatment of fluid flow as a momentum transfer process. Laminar and turbulent motion of compressible and incompressible fluids. Design of flow systems.

341. Transfer Processes and Separations II

Winter. 3(2-2) CHE 340.

Design of heat exchange equipment. Heat transfer in solids and flowing fluids. Multiple effect evaporation. Radiant heat exchange. Interphase transfer.

342. Transfer Processes and Separations III

Winter. 3(2-2) CHE 340.

Design of stagewise separation processes. Absorption, distillation, extraction, flash calculations, multicomponent separations. Graphical, analytical, and numerical methods of solution. Stage design and efficiency. Utilization of computer-aided design software.

343. Transfer Processes and Separations IV

Spring. 3(2-2) CHE 341, CHE 342.

Diffusion. Mass transfer coefficients. Design of continuous contacting systems. Counter-current processes. Fractionation. Contacting efficiency. Simultaneous momentum, heat, and mass transfer.

381. Chemical Engineering Analysis

Fall, Spring. 3(3-0) Students may not receive credit in both CHE 381 and MTH 341. MTH 310, CPS 112. Interdepartmental with the Department of Mathematics.

Formulation of ordinary and partial differential equations describing chemical systems. Boundary value problems, numerical methods, matrices, and applications, to chemical engineering systems.

411. Phase and Chemical Equilibria

Spring. 3(3-0) CEM 361, CHE 311.

Properties in solutions. Deviations from ideality. Liquid-vapor equilibria. Chemical equilibria in the gas, liquid, and solid states.

423. Chemical Engineering Laboratory

Fall, Summer. 3(1-6) CHE 428 concurrently, CHE 451 concurrently.

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

Winter, Spring. 3(1-6) CHE 341, CHE 342 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. 4(4-0) CEM 361, CHE 311, CHE 343.

Quantitative treatment of mechanisms and rates of chemical reactions. Catalysis. Design and analysis of flow and non-flow reactors. Heterogeneous catalysis.

442. Polymer Science and Engineering

Spring. 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

Winter. 3(3-0) CEM 361.

Structure and properties of inorganic and organic solids. Relation of bond type and steric configuration to mechanical, electrical, thermal, optical properties. Macroscopic structure influence on physical properties. Surface phenomena. Applications.

451. Process Systems Control

Fall. 3(3-0) CHE 343, CHE 428 or concurrently.

Foundation of control theory for chemical processes. Integration of present and developing practice with modern theory.

460. Problems and Reports

Fall, Winter, Spring, Summer. 1 to 9 credits. Seniors, approval of department.

Library and laboratory investigations of problems relating to departmental research.

461. Process Selection and Optimization

Winter. 5(5-0) CHE 343, CHE 428.

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) CHE 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 310. 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. Flowsheet optimization with process simulation packages.

470. Theory of Nuclear Reactors

Winter. 3(3-0) PHY 289, MTH 310 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

Spring. 3(3-0) CHE 342, 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 boundary layer theory.

801. Advanced Chemical Engineering Calculations I

Fall. 3(3-0) CHE 381.

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) CHE 801.

Continuation of CHE 801.

806. Thermodynamics and Kinetics in Chemical Engineering

Summer. 5(7-0) B.S. with a major in chemistry, biochemistry, or a closely allied area. Mathematics through calculus. College level physics. General physical, and organic chemistry. Not open to students with B.S. in chemical engineering for graduate credit.

Mass and energy balances in batch continuous and open systems. Process thermodynamics. Cryogenics. Properties of substances and mixtures. Phase equilibria. Chemical reaction equilibrium. Chemical reactor kinetics. Process design orientation.

807. Transfer and Separation Processes

Summer. 5(7-0) B.S. with a major in chemistry, biochemistry, or a closely allied area. Mathematics through calculus. College level physics. General physical, and organic chemistry. Not open to students with B.S. in chemical engineering for graduate credit.

Momentum, energy, and mass transfer. Laminar and turbulent flow. Fluid friction. Dimensional analysis. Heat through stationary and flowing materials. Interchangers. Condensation. Boiling. Binary and multicomponent distillation, absorption, extraction.