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.

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.

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.

920.   Advanced Plant Taxonomy
Spring of even-numbered years. 4(4-0) BOT 824, ZOL 441.
Consideration of the recent scientific developments affecting plant classification.

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.

956.   Advanced Plant Physiology IV
Spring of even-numbered years. 3(3-0) Approval of department.
Factors influencing vegetative and reproductive physiology.

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

See Agricultural Engineering

BUSINESS LAW AND OFFICE ADMINISTRATION   BOA

(Name change effective December 15, 1976. Formerly Business Law, Insurance and Office Administration.)

College of Business

201.   Shorthand I
Fall, Winter, Spring. 3(4-0) BOA 234 or 1 term typewriting.
Gregg shorthand theory, dictation and transcription for students with no previous training.

234.   Typewriting I
Fall, Winter, Spring. 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) BOA 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. 3(3-1) BOA 235 or 1-1/2 to 2 years typewriting.
Instruction in specialized typewriting problems to develop high-level competency.

304.   Shorthand II
Fall, Winter, Spring. 3(3-1) May reenroll for a maximum of 6 credits. BOA 201, BOA 235.
Development of theory and transcription competency, speed building.

308.   Secretarial Administration I
Winter, Spring. 4(4-0) BOA 236, BOA 304. Sophomores.
Development of proficiency in transcription skills.

309.   Secretarial Administration II
Fall, Spring. 4(4-2) BOA 236. Sophomores.
Machine dictation-transcription;duplication and copying processes; machine calculations; records management.

341.   Survey of Business Law
Fall, Winter, Spring. 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.   Administrative Office Management
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.

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.   Contracts and Sales
Fall, Winter, Spring, Summer. 3(3-0) BOA 440.
Contracts, including concept of freedom of contract and limitations. Sales. Case study method.

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

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

447.   Hotel Law
Winter, Spring. 4(4-0) BOA 440.
Legal aspects of the hospitality industry.

468.   Field Studies
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 8 credits. Approval of department.
Planned program of observation and work in selected business firms. Analysis and reports.

848.   The Legal Environment of Business
Fall, 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, antitrust, taxation, and transportation as related to foreign operations. Litigation and arbitration in the international business community.

871.   Seminar: Office Administration
Winter, Summer. 3 credits. May reenroll 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.

878A.   Seminar in Business Law
(878.) Winter. 4(4-0) BOA 848 or approval of department.
Contracts, sales, secured transactions and consumer legislation viewed from the judicial, legislative and executive vantage points.

878B.   Seminar in Business Law
Spring. 4(4-0) BOA 848 or approval of department.
Agency, partnerships and corporations, viewed from legislative, judicial and executive vantage points, as they affect entrepreneurial decision making.

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

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.
Pollution of air, water and land. Adulteration of foods. Overtaxing waste facilities. Depleting natural resources. Interaction of engineers, industry, government, and the public in creating and combating these problems.

300. **Material and Energy Balances**
Fall, Winter. 4(3-2) One year general chemistry, MTH 214 or concurrently, CPS 120 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 termperature, phase changes, chemical reactions.

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. Radiant heat transfer. Application to engineering equipment. Mass transfer in single-phase systems, transport analogies interphase transfer and contacting of immissible phases.

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

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.

381. **Chemical Engineering Analysis**
Fall, Spring. 3(3-0) Students may not receive credit in both CHE 381 and MTH 341. MTH 310. 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**
Fall. 3(3-0) CEM 361, CHE 311 or concurrently.
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**
Fall, Summer. 3(1-6) CHE 307.
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 306.
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**
Spring. 3(3-0) CEM 361, CHE 306, CHE 311.
Quantitative treatment of mechanisms and rates of chemical reactions. Catalysis. Design and analysis of flow and non-flow reactors. Interpretation of laboratory kinetic data.

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**
Winter. 3(3-0) CHE 307, CHE 428.
Foundation of control theory for chemical processes. Integration of present and developing practice with modern theory.

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. 5(5-0) CHE 307, 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**
Fall, 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.

470. **Theory of Nuclear Reactors**
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**
Fall. 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 boundary layer theory.

801. **Advanced Chemical Engineering Calculations I**
Fall. 3(3-0) CHE 307.
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. 4(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 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 Sepatation Processes**
Summer. 4(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 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.

808. **Transport Phenomena**
Summer. 4(3-2) B. S. with a major in chemistry, biochemistry, or a closely allied area. CHE 807. Not open to students with B. S. in chemical engineering for graduate credit.
Differential equations of motion, continuity, energy and mass. Concepts of fluid behavior. Unsteady heat conduction. Radiation. Numerical and analytical solutions. Diffusion. Convective coefficients. Boundary layers. Simultaneous momentum, mass, heat transfer and chemical reaction.