leocologic interpretation of most sedimentary accumulations and rocks. (Includes certain algae, protozoans, similar organisms of uncertain affinity and disassociated fragments of larger organisms.)

835. **Morphogenesis of Reproductive Structures**  
Spring of even numbered years. 4(3-4)
Principles underlying the differentiation and growth of reproductive plant structures with special emphasis upon their functional and developmental genetic relationships.

836. **Advanced Mycology: Current Biological Advances**  
Spring of even-numbered years. 4(4-0)  
Approval of department.
Recent and current advances in the biology of fungi, with emphasis upon experimental studies of structural and functional differentiation during conjugation.

837. **Advanced Mycology: Morphology and Taxonomy**  
Spring. 4(3-2) 402.
Recent morphological studies, taxonomic methods, and phylogeny. The laboratory will be devoted to special problems related to the student’s interests.

838. **Advanced Paleobotany**  
Winter. 3(2-4) Approval of department. Interdepartmental with the Geology Department.
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. 6 credits. Approval of department. Given at W. K. Kellogg Biological Station. Interdepartmental with and administered by the Zoology Department.
An experimental-field approach to the study of populations and communities. Selected topics will deal with population growth, composition, predation, community structure and species abundance. This course is intended to complement ZOL 882.

841. **Physiology of the Algae**  
Spring of even-numbered years. 4(3-2)  
Approval of department.
Physiology, chemistry, biochemistry, and aspects of the ultra-structure of the various algal divisions. Discussion of use of algae for the study of classical physiological and developmental problems.

845. **Current Problems in Plant Metabolism**  
Fall, Winter, Spring. 1(1-0) 414.

846. **Seminar in Plant Pathology**  
Fall, Winter, Spring. 1(1-0)  
Approval of department.

855. **Effects of Ionizing Radiations on Plants**  
Spring of odd-numbered years. 3(3-0)  
Approval of department.
Nature of ionizing radiations related to their effects upon plant growth and development including aspects of radiation sensitivity, dosimetry, direct and indirect effects, genetics, evolution and environmental implications related to modes of action at the cell, organism, and population levels.

880. **Plant Virology**  
Fall. 3(2-6) 405 or approval of department.
External and internal symptomatology, transmission, interrelations, purification, assay and serology of plant viruses.

881. **Pathogenesis and Disease Resistance**  
Winter of odd-numbered years. 4(3-2) 405 and 415, or approval of department.
Lectures, readings, and discussions on mechanisms of pathogenicity and infectivity; physiology and biochemistry of disease development; tumorgenesis; metabolic consequences of infection; nature of disease resistance; and parasitism.

883. **Plant Disease Control**  
Fall of even-numbered years. 3(3-2) 405.
Principal 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.

885. **Plant Diseases in the Field**  
Spring. 4 credits. 405 and approval of department.
Diagnosis, distribution and sequential developments of plant diseases in the field.

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, fungidal action, and soil microbiology.

999. **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, paleobotany, pathology, physiology, and taxonomy.

**Building Construction**
See Packaging

**Business Law and Office Administration**

**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.

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, Summer. 2(2-2) 234 or approval of department.
Improvement of speed and accuracy; arrangement of business letters, tabulation and manuscript 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.

304. **Advanced Shorthand**  
(204.) Fall, Winter, Spring. 3(3-1) May re-enroll for a maximum of 6 credits. 202, 235.
Continuation of 202.
305. Secretarial Administration I  
Fall, Winter, Spring. 4(4-0) 236.  
304. 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. 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.

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, earnest money deposits, mechanics liens, co-ownership, division 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.  

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

465. 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.

484. 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 legal functions vary.

489. 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.

571. Seminar: Office Administration  
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.

578. Seminar in Business Law  
Fall, Spring. 4(4-0)  
May re-enroll for a maximum of 8 credits. 484 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.

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

CHEMICAL ENGINEERING CHE  
College of Engineering

201. Chemical Engineering Calculations  
Fall, Winter. 3(3-0) CEM 153; MTH 214; PHY 257 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  
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) 301 or concurrently; MTH 215.  

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

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

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

401. Applied Process Analysis  
Spring. 3(3-0) CEM 130 or 141; MTH 113; or approval of department. Students may not earn credit in both 401 and 201.  
Techniques of process analysis applied to natural environmental, and physical systems. Material and energy balances; diffusion, heat conduction and viscous flow. For majors in natural sciences and non-chemical engineers.

429. Chemical Engineering Laboratory  
Fall, Winter. 4(0-12) 302.  
Assigned projects requiring laboratory investigations. Experimental work involving transport phenomena, momentum, heat, and mass transfer, separation processes such as distillation, filtration, and drying; thermodynamics and reactor kinetics.

435. Chemical Reaction Engineering  
Fall. 3(3-0) 303; CEM 362, 451.  

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 con-