826. Advanced Tropical Botany
Summer. 12 credits. Approval of department and acceptance by Organization for Tropical Studies.
A field course on the adaptation, evolution, and physiological characteristics of tropical plants. The subject will vary from term to term, but will include such topics as the reproductive biology of tropical plants, tropical forest ecology, biology of tropical epiphytes, biology of tropical grasses, biology of tropical ferns, etc.

827. General Cytology
Spring and Summer of odd-numbered years. 3.28. One year general chemistry and one year general botany or general zoology. Designed primarily for biological science students. Plant and animal materials. Cell morphology and variation, organization and distribution of standard inclusions, structure of the nucleus and the mechanism of mitosis.

830. Paleobotany
Fall. 4(3-4) Approval of department.
Interdepartmental with the Geology Department.
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 Geology Department.
An introduction to the principles and techniques of spore and pollen analysis, both fossil and recent, and utilization of plant microfossils for stratigraphic determinations and palynologic interpretation of most sedimentary accumulations and rocks. (Includes certain algae, protozoa, similar organisms of uncertain affinity and dissociated fragments of larger organisms.)

835. Morphogenesis of Reproductive Structures
Spring of even numbered years. 4(3-4)
344. 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
Winter. 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 ontogeny.

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. Micropscopic analysis of tissues and organs prepared by thin section, transfers, peels, polished and etched surfaces, and maceration.

839. Population Ecology
Summer of odd-numbered years. 6 credits. Approval of department. Given at W. K. Kellogg Biological Station. Interdepartmental with and administered by the Zoology Department.
A synopsis of growth and regulation of plant and animal populations; interrelationships of biotic and environmental factors that control population responses and interactions. Laboratory and field experiments.

841. Physiology of the Algae
Spring. 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(2-0)
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, genetic, evolutionary and environmental implications related to modes of action at the cell, organism, and population levels.

880. Plant Virology
Fall. 5(2-6) 405 or approval of department.
External and internal symptomatology, transmission, interactions, purifications, assay and serology of plant viruses.

881. Parasitism and Pathogenesis
Winter of odd-numbered years. 4(2-4) 415, 405, or approval of department.
Physiology of parasitism and disease development in plants. Parasitism by plant pathogens is compared with parasitism in other groups.

883. Plant Disease Control
Fall. 3(2-3) 405.
Principles 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.

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, 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, physiology, and taxonomy.

915. 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 phenogenetics.

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

920. Advanced Plant Taxonomy
Spring of even-numbered years. 4(4-0)

894. Advanced Mycology: Advanced Mycology: Morphology, anatomy, phylogenetic relationships and classification of fossil plants. Micropscopic analysis of tissues and organs prepared by thin section, transfers, peels, polished and etched surfaces, and maceration.

941. Advanced Mycology: Advanced Mycology: Morphology, anatomy, phylogenetic relationships and classification of fossil plants. Micropscopic analysis of tissues and organs prepared by thin section, transfers, peels, polished and etched surfaces, and maceration.

945. Advanced Plant Physiology III
Spring of odd-numbered years. 3(3-0)

946. Advanced Plant Physiology IV
Fall of odd-numbered years. 3(3-0)

947. Advanced Plant Physiology V
Winter of even-numbered years. 3(3-0)

948. Advanced Plant Physiology VI
Spring of even-numbered years. 3(3-0)

949. Factors influencing vegetative and reproductive physiology.

989. 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, pathology, physiology, and taxonomy.

BUILDING CONSTRUCTION
See Packaging

BUSINESS LAW AND OFFICE ADMINISTRATION

College of Business

201. Shorthand I
Fall, Winter, Spring. Summer. 4(4-0) 234 or 1 term typing course.
Basic principles, elementary vocabulary, beginning dictation, and transcription for students with no previous training.

A-19
202. Shorthand II  
Fall, Winter, Spring, Summer. 4(4-0)  
201, 234 or 1 term shorthand and typewriting,  
writing.  
Continuation of 201. Vocabulary, dictation, and  
transcription.

203. Shorthand III  
Fall, Winter, Spring. 4(4-0) 203,  
Continuation of 202 with development of speed  
and accuracy.

204. Advanced Shorthand  
Fall, Winter, Spring. 4(4-4) 204,  
Continuation of 203. Speed writing from dicta-  
tion.

234. Typewriting I  
Fall, Winter, Spring, Summer, 2(2-2)  
Approval of department.  
Mastery of keyboard, building speed and ac-  
curacy; elementary typewriting problems.

235. Typewriting II  
Fall, Winter, Spring. 2(2-2) 234 or  
approval of department.  
Improvement of speed and accuracy; arrange-  
ment of business letters, tabulation and manu-  
scripts; 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. Secretarial Administration I  
Fall, Winter, Spring. 4(4-0) 204,  
Sophomores.  
Development of proficiency in transcription  
skills.

309. Secretarial Administration II  
Fall, Winter, Spring. 5(5-0) 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 writ- 
ing 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,  
criminal law; contracts, agency, sales, negotiable  
instruments, real and personal property, includ- 
ing 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; re-  
sponsibilities 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. 5(5-0) Seniors or  
approval of department.  
Analysis of the role of the executive secretary.

427. Business and Technical Reports  
Fall, Winter, Spring, Summer. 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  
citizens and businessmen to governmental agen-  
cies. Torts, crimes.

441. Law of Contracts and Business  
Organizations  
Fall, Winter, Spring, Summer. 5(5-0)  
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  
baileys, 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  
leases, mortgages, land descriptions, titles,  
deeds, recording requirements, brokers, land  
contracts, escrows, closing of sales, abstracts,  
mortgages, mechanics liens, co-ownerships, de-  
feat and distribution, administration of estates,  
zoning, taxation, landlord and tenant. Combined  
text and case approach.

448. 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 di-  
rected studies.

447. Hotel Law  
Winter, Spring. 4(4-0) 440.  
Negotiable instruments, warranties, property,  
torts, civil rights, agencies, partnerships, corpo-  
ations as applied to hotel and restaurant manage- 
ment.

450. Field Studies  
Fall, Winter, Spring, Summer. Variable  
credit. May re-enroll for a maximum of 8  
credits. Business minors and approval of depart- 
ment.  
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 com-  
ponent elements of the legal environment of  
business and the structural framework in which  
legal functions.

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

871. Seminar: Office Management  
Winter. 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 admin- 
istrative systems and procedures in the office.

878. Seminar in Business Law  
Fall, Spring. 3(3-0) May re-enroll for a maximum  
of 6 credits.  
Approval of department.  
Public policy with regard to contracts, antitrust,  
secure 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  

201. Chemical Engineering Calculations  
Fall, Winter. 3(3-0) CEM 153, MTH  
214; PHY 207 or concurrently.  
Chemical engineering calculations. Organization  
of calculations. Material balances, energy bal- 
ances, 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,  
capacity, 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 sub- 
estances.

203. Thermodynamics for Chemical  
Engineering  
Fall, Winter. 3(3-0) 202, MTH 215.  
Partial molar quantities. Chemical potential,  
Entropy and activity. Phase equilibria in multi- 
component systems. Chemical reaction equilibria  
in homogeneous, heterogeneous, and electrochemical  
systems. Statistical significance of energy and  
entropy. Use of quantum theory to calculate  
thermodynamic properties.

301. Transfer Processes and  
Separations  
Fall, Winter. 4(4-0) 301, 381 or  
concurrently; MTH 215.  
Thermodynamics of fluid flow. Application to  
flow equipment. Frictional effects for laminar  
and turbulent motion of compressible and in- 
compressible fluids. Dimensional analysis and  
similitude. Continuity and flow equations in ten- 
sor notation. Treatment of fluid flow as a mo- 
mentum transfer process. Analogue treatment of  
heat flow. Heat transfer in solids and flowing  
fluids.