BIOMEDICAL ENGINEERING  BME
College of Engineering

410.  Electronic Instrumentation in Biology and Medicine Fall. 4(4-0)  MTH 112, PHY 338 or approval of instructor.

411.  Electric Theory of Nerves  Winter. 4(4-0)  MTH 215, PHY 288.

424.  Materials in Biomedical Engineering  Winter. 3(3-0)  FSL 331 or approval of department.
Basic principles 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.

451.  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.

BIOPHYSICS  BPY
College of Human Medicine
College of Natural Science
College of Osteopathic Medicine

402.  Introduction to Biophysics  Spring. 5(5-0)  PHY 230, MTH 113, 1 year organic chemistry and 1 year biology.
Basic principles and methods of biophysics, including thermodynamics, statistical mechanics, quantum mechanics, quantum chemistry, and physical chemistry. Emphasis on mathematical methods and applications to biophysical problems. Use of computer in solving biophysical problems.

450.  Special Topics in Biophysics  Fall, Winter, Spring, Summer. 2 to 4 credits. Approval of department; 402 recommended.
Special topics within five areas of biophysics: structure-function correlation, neurophysiology, membrane biophysics, molecular biophysics, and theoretical biophysics.

499.  Independent Study  Fall, Winter, Spring, Summer. 1 to 5 credits. May be re-enrolled for a maximum of 15 credits. Approval of department. Undergraduate research under one of our faculty.

821.  Molecular Biophysics  Fall of odd-numbered years. 5(3-4)  Approval of department.

Fundamental electrical properties, dielectric properties and photoconductivity effects and their relevance to the biological functioning of these molecules.

823.  Radiation Biophysics  Spring of even-numbered years. 3(2-2)  Approval of department.
Effects of various types of ionizing radiation and ultraviolet and visible light on proteins, nucleic acids, viruses and plant and animal cells. Damage and repair mechanisms at the molecular level.

824.  Membrane Biophysics  Fall of even-numbered years. 4(3-2)  Approval of department.
Membrane Biophysics will cover interfacial phenomena in biology and chemistry; structure and function, theoretical and experimental models, for biological membranes, membrane biochemistry. Labs will emphasize bimolecular lipid membrane (BLM) techniques.

825.  Basic Neurobiology  Winter of odd-numbered years. 4(2-3)  Approval of department.
A comparative survey of fundamental principles of nervous organization will be undertaken in lectures. Laboratory will emphasize examination of prepared neuroanatomical material and a demonstration of important neurophysiological phenomena.

826.  Cellular Biophysics  Spring. 4(3-2)  Approval of department.
Basic cell structure and function at the molecular level. Emphasis will be on genetic and molecular control of cellular systems.

834.  Membranes: Natural and Artificial  Spring of odd-numbered years. 2 to 3 credits. May re-enroll for a maximum of 3 credits. Approval of department.
Emphasis is placed on the biophysical and biochemical characterization of biological membranes and their theoretical and experimental models. Presentation and discussion by students and staff of recent advances in membrane research.

855.  Vertebrate Neural Systems I  Fall of odd-numbered years. 5(3-4)  Approval of department; ANT 815 and BPY 823 recommended. Interdepartmental with the Zoology, Psychology and Physiology Departments and administered by the Zoology Department.
Structure and function of major component systems of vertebrate brains; their evolution, ontogeny and comparative analysis in mammals, birds, reptiles, amphibians and fish. Interrelation of behavioral, anatomical and physiological studies.

900.  Readings in Biophysics  Fall, Winter, Spring. 3 to 6 credits. Approval of department.
Reading course in special topics adapted to the individual preparation and needs of the student.

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

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

BOTANY AND PLANT PATHOLOGY  BOT
College of Agriculture and Natural Resources
College of Natural Science

IDC.  Resource Ecology and Man  For course description, see Interdisciplinary Courses.

201.  Plants and Man  (3-0)  Winter, Spring. 3(3-0)
The relevance of plants to modern society with emphasis on those plants which supply drugs, food, fuel and oxygen, and those which have historical or aesthetic importance.
Descriptions — Botany and Plant Pathology of Courses

205. Plant Biology
Fall, Winter. 3(3-0) High school chemistry and high school algebra.
An introduction to plant science for students lacking a general knowledge of the principles of plant biology as well as for prospective plant science majors.

301. Introductory Plant Physiology
Fall. 4(2-4) CEM 131 or 141; 181; B S 211 and introductory organic chemistry recommended.
General principles of plant physiology relating plant function to structure.

302. Introductory Morphology
Fall. Winter. 4(2-4) B S 212 or approval of department.
Structures and life cycles of representative plant groups showing progressive evolutionary developments.

315. Introductory Plant Systematics
Spring. 4(2-3) 302 or B S 212 or approval of department.
Plant diversity with emphasis on identification, classification, and evolutionary relationships of vascular plants.

335. Fossil Plants, Their History and Paleoecology
Spring. 3(3-0) One course in geology or botany or biology or approval of department.
Intersplemental and administered by the Geology Department.
History of plants through geologic time; their form and evolution; how and where found; identification and reconstructed; their use in determining ancient geographic patterns, palaeoenvironments, palaeoclimates and community structure. Field trip.

336. Economic Plants
Fall. 3(3-0)
Histories, characteristics, and origin of plants used in industrial processes, drug manufacture, and agriculture. Nontechnical to broaden student's cultural interest in plants.

400. Aquatic Plants
Spring. 3(1-4) One year of botany and zoology or approval of department.
Aquatic plants, their classification, ecology and economic importance. Relationships to problems in fisheries, wildlife management, and to 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. Special Problems
Fall, Winter, Spring, Summer. 1 to 4 credits. May re-enroll for a maximum of 16 credits. 302, Seniors, approval of department.
Students with special ability may carry on laboratory research under study of published literature on a selected topic.

402. Introductory Mycology
Fall, Winter. 4(2-6) B S 212 or approval of department.
Survey of the fungus, a background course for students taking plant pathology or other courses in mycology.

405. Introductory Plant Pathology
Fall. 4(2-3) 302 or B S 212 or approval of department. Students may not receive credit in both 402 and 405.
General principles of plant pathology including detailed study of selected diseases as examples of important groups.

408. Medical Mycology
Fall, Spring. 4(2-6) 402 or approval of department with the Department of Microbiology and Public Health.
Characteristics, habits, and laboratory identification of fungal diseases infecting humans. Emphasis on laboratory techniques and morphological characteristics of the various mycoses.

407. Diseases of Forest and Shade Trees
Spring. 4(3-3) 301; 302; 318 or FOR 204. Students may not receive credit in both 405 and 407.
Diseases which affect trees in forests, parks, suburbs and nurseries, and methods of control.

408. Freshwater Ecology
Summer. 4 credits. B S 212 or approval of department. Given at W. K. Kellogg Biological Station. Intersdepartmental with Biological Science and the Department of Zoology and administered by Biological Science.
The ecology of freshwater ecosystems, their biotic structure, and the functional interrelationships of environmental variables regulating population dynamics, productivity, and community structure. Extensive field investigations.

410. Terrestrial Ecology
Summer. 6 credits. B S 212 or approval of department. Given at W. K. Kellogg Biological Station. Intersdepartmental with Biological Science and the Department of Zoology and administered by Biological Science.
Factors determining distribution and abundance. Interrelationship of plants, animals, and environment. Extensive field investigations of several types of terrestrial communities in light of current theories.

411. Systematic Botany
Summer. 4(2-4) B S 212 or approval of department.
Taxonomy, identification, and evolutionary relationships of vascular plants, illustrated by the local flora; extensive field studies.

414. Plant Physiology: Metabolism
Winter, Summer. Odd-numbered years. 4(3-4) 302; 1 year chemistry including organic.
Comprehensive study of metabolic activities of plants. Emphasis on mineral nutrition of plants and processes of photosynthesis, protein synthesis, and respiration.

415. Plant Physiology: Growth
Spring, Summer. Odd-numbered years. 4(3-4) 414.
Comprehensive study of growth processes of plants, with emphasis on germination, dormancy, hormones, and physiological phenomena associated with plants of development.

457. Cell Biology
Winter. Summer. Odd-numbered years. 4(4-0) BCH 200 and one year of general botany or general zoology.
Cell organization and distribution of standard organelles. Structure and function of the nucleus and other cytoplasmic organelles.

431. Histological Techniques
Winter. 4(2-6) 302.
Preparation of plant materials for microscopic study. Special emphasis on the many variations in microtechnique, including paraffin and cellulose embedding, freezing microtome and ultrathin sectioning for electron microscopy.

434. Plant Anatomy
Fall. Summer. Even-numbered years. 4(3-4) 303.
Principles underlying the differentiation and growth of vegetative plant structures with special emphasis upon their functional and developmental genetic relationships.

441. Phytogeography
Winter. 3(3-0) 302.
Distribution of plants over the earth, with special reference to North America. Geologic history and environmental factors which influence distribution.

447. Fresh Water Algae
Spring. 4(3-4) One year botany or zoology. Primarily for students in Fisheries Biology, Wildlife Management and Sanitary Engineering.
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(3-4) 318; 301 or 414
Interrelationships of plants and environment. Factors which govern their distribution.

470. Nematodes Diseases of Economic Plants
Winter of odd-numbered years. 4(3-4) Intersdepartmental with and administered by the Department of Entomology.
Major nematode diseases of economically important plants, with emphasis on diagnostic symptoms, nematology and principles of control.

480. Insects in Relation to Plant Diseases
Winter of even-numbered years. 4(3-4) 302. Interdepartmental with and administered by the Department of Entomology.
Relationships of insects, mites and nematodes to important plant diseases incited by bacteria, fungi, viruses and toxins. Mode of transmission and means of control. Transmission techniques and important plant-pathogen-insect relationships.

499. Senior Seminar
Winter. 1(1-0) May re-enroll 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.

500. Special Problems in Taxonomy
Fall, Winter, Spring. 1 to 15 credits. Approval of department.

501. Special Problems in Anatomy and Morphology
Fall, Winter, Spring. 1 to 15 credits. Approval of department.

502. Special Problems in Pathology
Fall, Winter, Spring, Summer. 1 to 15 credits. Approval of department.

503. Special Problems in Physiology
Fall, Winter, Summer. 1 to 15 credits. Approval of department.

505. Special Problems in Mycology
Fall, Winter, Spring. 1 to 15 credits. Approval of department.

508. Special Problems in Cytology and Genetics
Fall, Winter, Spring. 1 to 15 credits. Approval of department.

507. Special Problems in Algae
Fall, Winter, Spring. 1 to 15 credits. Approval of department.

A-26
Botany and Plant Pathology — Descriptions of Courses

809. Special Problems in Ecology
Fall, Winter, Spring, Summer. 1 to 15 credits. Approval of department.

812. Ecology and Epidemiology of Plant Pathogens
Winter of even-numbered years. 4(2-4)
402, 405; or approval of department.
Production, liberation and dispersal of inoculum; effect of leaf and root exudates on pathogens; pathogen survival in the absence of the host plant; microbial antagonism. Nature and causes of epidemics.

813. Special Problems
Fall, Winter, Spring, 1 to 4 credits. May re-enroll for a maximum of 18 credits. Approval of department.

816. Industrial Mycology
Winter of odd-numbered years. 3(3-3)
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.

820. Ecology of Hydrophytes
Summer of every third year, given in 1974. 3 credits. 400 and 447 or approval of department. Given at W. K. Kellogg Biological Station.
Physiological and ecological relationships of periphyton, macroalgae, and vascular aquatic plants. Field and laboratory methods of analysis of growth factors.

823. Plant Taxonomy I
Fall of odd-numbered years. 4(3-3)
318; ZOL 441 recommended. First course of a series on classification and relationships of vascular plants. Family characterization, patterns, geographic distribution, and evolutionary trends are stressed. Contributions from classical taxonomy, cytogenetics and experimental taxonomy are discussed.

824. Plant Taxonomy II
Winter of even-numbered years. 4(3-3)
833. Second course of a series on classification and relationships of vascular plants.

825. Tropical Biology: An Ecological Approach
Winter, Summer. 12 credits. Approval of department and acceptance by Organization for Tropical Studies. Interdepartmental with the Zoology Department.
An introduction in the field to the principles of ecology as they operate in the tropics, especially concerning the tropical environment and biota, ecological relations, communities and evolution in the tropics. Given in Costa Rica by Organization for Tropical Studies.

826. Advanced Tropical Botany
Winter, Summer. 12 credits. Approval of department and acceptance by Organization for Tropical Studies. Interdepartmental with the Zoology Department.
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 ferns, etc.

828. Cytogenetics
(910.) Fall. 4(2-4) 407 or ZOL 441 or approval of department.
Detailed discussions of mitosis and meiosis; mechanism of chromosome movement; fine structure of chromosomes and spindle apparatus; changes of chromosome number and structure and their genetic significance.

830. Paleobotany
Fall. 3(3) Approval of department. Interdepartmental with the Geology Department.
Survey of fossil plants: their preservation, occurrences, geography, palaeoecography, palaeoecology, evolutionary history, classification and representative types. One weekend field trip to fossil plant locality.

831. Palynology
Spring. 4(3-3) 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 palaeoecologic interpretation of most sedimentary accumulations and rocks. (Includes certain algae, protozoans, similar organisms of uncertain affinity and dissociated fragments of larger organisms.)

835. Morphogenesis of Reproductive Structures
Spring of even-numbered years. 4(3-4)
434. 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 asexual life cycles.

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(4-4) 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, competition, predation, community structure and species abundance. This course is intended to complement ZOL 482.

841. Physiology of the Algae
Spring of even-numbered years. 4(3-3)
Approval of department.
Physiology, biochemistry, 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.

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 systematic, evolution, ecology, geography and economic significance of the grass family, including pertinent aspects of genetics, cytology, anatomy and physiology.

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, genetic, evolutionary and environmental implications related to modes of action at the cell, organism, and population levels.

871. Biology of Nematodes
Winter of even-numbered years. 4(2-4)
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 phyto-pathogenic species.

878. Comparative Limnology
Summer. 6 credits. Approval of department. Given at W. K. Kellogg Biological Station. Interdepartmental with and administered by the Zoology Department.
Theoretical concepts and methods of analysis of environmental parameters influencing productivity of freshwater. Comparative field investigations of lakes, streams, and other aquatic habitats.

880. Plant Virology
Fall of odd-numbered years. 5(2-3)
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) 405 and 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.

883. Plant Disease Control
Fall of even-numbered years. 3(3-3)
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.

885. Plant Diseases in the Field
Spring. 4 credits. 405 and approval of department.
Diagnosis, distribution and sequential development of plant disease 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, fungal action, and soil microbiology.
BUILDING CONSTRUCTION

See Packaging

BUSINESS LAW, INSURANCE AND ADMINISTRATION

BIO

College of Business

201. Shorthand I
Fall, Winter, Spring. 3(4-0) 234 or 235 term typing.
Gregg shorthand theory, dictation and transcription for students with no previous training.

202. Shorthand II
Fall, Winter, Spring. 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. 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; predication typewriting.

238. Advanced Typewriting
Fall, Winter, Spring. 3(3-1) 233 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.

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

309. Secretarial Administration II
Fall, Winter, Spring. 4(4-0) 236, 308.
Sophomores.
Machine dictation-transcription; duplication and copying processes; machine calculations; record management.

326. Business Writing
Fall, Winter, Spring. 4(4-0) Juniors.
Study and analysis of business and industrial communication problems; extensive instruction and practice in writing.

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.

350. Principles of Risk and Insurance
(AFA 350) Fall, Winter, Spring. 3(3-0) Juniors or approval of department.
Risk and risk meeting methods with emphasis on the insurance mechanism. Fundamental principles, legal relationships, types of carriers and organization principle types of coverage and industry regulation.

370. Administrative Office Management
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.

395. Principles of Urban Real Estate Administration
(AFA 385) Fall, Spring. 5(5-0) AFA 391 or approval of department; EC 201.
Concepts of urbanism, city functions and city growth. Examines physical, locational, legal, social and economic factors. Role of markets, governments and finance. Theories and techniques of valuing urban real estate.

396. Personal Risks and Insurance
(AFA 396) Fall, Summer. 3(3-0) 350 or Juniors in business administration.

397. Social Insurance Topics
(AFA 397) Fall. 4(4-0) EC 200.
Systematic study of the legal, ethical, social and political aspects of social insurances. Federal and State programs will be analyzed. Problems, solutions and potential alternatives to be discussed.

400H. Honors Work
Fall, Winter, Spring. 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. 3(3-0) Seniors or approval of department.
Legal reasoning and legal institutions. Court systems and court procedure. Relationships of citizen and businessman to governmental agencies. Torts, crimes.

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

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