420. *Seminar in Recent Advances in Biological Science*

Fall, Winter ,Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 6 credits if different topic is taken. Approval of department.

A series of lectures by senior faculty of topics on the history, development, the most recent advances and the possible future and limits of the Biological Sciences.

422. *Terrestrial Field Biology for Teachers*

Summer. 3 credits. A course in biology or approval of department. Given at W. K. Kellogg Biological Station.

Ecology of forest, field and prairie ecosystems. Emphasis on natural history and field identification of Michigan's common land plants and animals. Biological collection techniques and reference materials.

425. *Aquatic Field Biology for Teachers*

Summer of even-numbered years. 3 credits. A course in biology or approval of department. Given at W. K. Kellogg Biological Station.

Investigation of Michigan's aquatic and wetland ecosystems with special emphasis on field identification of key plant and animal species. Ecological concepts, reference materials, and biological collection techniques.

440. *Man and Environment Workshop for Teachers*

Summer. 3 credits. Approval of department. Given at W. K. Kellogg Biological Station.

Discussions and practical work sessions concerning the development of ideas and activities for environmental studies in and outside the classroom. Designed for intermediate and secondary inservice teachers.

460. *Ornithology for Teachers*

Summer. 3 credits. A course in biology or approval of department. Not open to Zoology majors. Given at W. K. Kellogg Biological Station. Interdepartmental with and administered by the Department of Zoology.

Distribution, breeding cycles, migration, food and feeding habits, voice and other important areas of avian biology. Emphasis on field identification and natural history.

499. *Research*

Fall, Winter, Spring. 2 to 4 credits. May reenroll for a maximum of 12 credits. Approval of director of biological science program and student's adviser.

Undergraduates are invited on an individual basis into research laboratories of faculty in biological departments of the college. After three terms of research, a presentation in thesis form is produced and defended.

800. *Problems in Biological Science*

Fall, Winter, Spring. Variable credit. B.S. degree in biological Science.

805. *Outdoor Environmental Studies*

(451.) Summer. 1 to 4 credits. May reenroll for a maximum of 9 credits if different topics are taken. B S 422 or B S 425 or ZOL 460 or approval of department. Given at W. K. Kellogg Biological Station.

Emphasis on environmental understanding. Development of educational materials through team research and testing. Interaction with elementary and middle school children in two-week outdoor oriented workshop.

899. *Master's Thesis Research*

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

BIOMECHANICS BIM

College of Osteopathic Medicine

560. *Acupuncture and Other Peripheral Stimulation Therapy*

Winter. 1 to 3 credits. Approval of department.

Clinical application of traditional Chinese acupuncture and related peripheral stimulation therapies.

561. *Clinical Craniosacral Manipulative Therapy*

Spring. 1 to 3 credits. Approval of department.

Basic concepts of the craniosacral system, clinical applications.

590. *Special Problems in Biomechanics*

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

Each student will work under direction of a faculty member on an experimental, theoretical or applied problem.

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.

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.

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.

BIOPHYSICS BPY

College of Human Medicine
College of Natural Science

400H. *Honors Work in Biophysics*

Fall, Winter, Spring, Summer. 3 to 6 credits. May reenroll for a maximum of 6 credits. Approval of department.

Independent study and investigation under the direction of a faculty member.

402. *Introductory Biophysics: Molecular and Thermal*

Spring. 3(3-0) One year organic chemistry or biochemistry; 1 year biology, PHY 239, PHY 259, MTH 113, or approval of department.

Salient features of biophysics; principles and methods. Structure, function, and organization of biologic molecules; molecular biophysics; thermal biophysics; bioenergetics and photobiology.

403. Introductory Biophysics: Membranes and Electrical

Fall. 3(3-0) One year organic chemistry or biochemistry, PHY 239, PHY 259; MTH 113 or approval of department.

Salient features of biophysics, principles and methods; radiation biophysics; membrane biophysics; bioelectric phenomena; neurobiology; and psychophysics.

450. Introduction to the Nervous System

Spring of even-numbered years. 3(3-0) B S 211, B S 212.

Nervous structure and function from protozoa (aneural) to mammals normal and abnormal innate and learned behavior in animals and humans from the cellular level to the intact organism; emergence of mind and consciousness.

480. Special Topics in Biophysics

Fall, Winter, Spring, Summer. 2 to 4 credits. Approval of department; BPY 402 recommended.

Special topics within five areas of biophysics: structure-function correlation, neurobiophysics, membrane biophysics, molecular biophysics, or theoretical biophysics.

499. Independent Study

Fall, Winter, Spring, Summer. 1 to 5 credits. May reenroll for a maximum of 15 credits. Approval of department.

Undergraduate research under one of our faculty.

804A. Neuroscience Laboratory I

Winter. 4(2-4) Approval of instructor. Interdepartmental with the departments of Physiology, Psychology, and Zoology. Administered by the Department of Psychology.

Development of skills in the methods, techniques and instrumentation necessary for research in a variety of areas concerned with neuroscience.

804B. Neuroscience Laboratory II

Spring. 4(2-4) PSY 804A. Interdepartmental with the departments of Physiology, Psychology, and Zoology. Administered by the Department of Psychology.

Continuation of BPY 804A.

821. Molecular Biophysics

Winter of even-numbered years. 4(4-0) Approval of department.

Theoretical/experimental methods for determination of electronic structure, excited states and spectroscopy of biological systems. Biological energy transfer. Quantum processes in photosynthesis. Exciton effects in photoreceptors and pigments. Conformational changes.

822. Charge Transport and Solid State Processes

Spring of even-numbered years. 4(4-0) Approval of department.

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

824. Membrane Biophysics

Winter of odd-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 biomolecular lipid membrane (BLM) techniques.

826. Cellular Biophysics

Spring of odd-numbered years. 4(4-0) Approval of department.

Basic cell structure and function at the molecular level. Emphasis will be on genetic and molecular controls of cellular systems.

834. Membranes: Natural and Artificial

Spring of odd-numbered years. 2 to 3 credits. May reenroll 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.

850. Simpler Systems Approaches to Learning and Memory

Winter of odd-numbered years. 4(4-0) BPY 450 or BPY 827.

Simpler invertebrate and vertebrate, nervous systems which have been or could be useful for electrophysiological and molecular approaches to learning and memory.

865. Advanced Neurobiology

(BIM 865.) Spring. 4(4-0) BPY 827. Interdepartmental with the departments of Anatomy, Physiology, Psychology, and Zoology. Administered by the Department of Anatomy.

Basic organization structure and function of neural networks comprising sensory, motor, and autonomic systems including examples from invertebrates and vertebrates. Attendance at neuroscience seminar is required.

880. Special Topics in Biophysics

Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 15 credits.

Special topics within the five subdivisions of biophysics; structure, organization and function of biological phenomena, sensory perception, and psychophysics and biomechanics.

885. Vertebrate Neural Systems I

Fall of odd-numbered years. 5(3-4) Approval of department: ANT 815 and BPY 827 recommended. Interdepartmental with the departments of Zoology, Physiology, and Psychology. Administered by the Department of Psychology.

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.

886. Vertebrate Neural Systems II

Winter of even-numbered years. 5(3-4) PSY 885. Interdepartmental with the departments of Psychology, Physiology, and Zoology. Administered by the Department of Zoology.

Continuation of BPY 885. 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.

890. Readings in Biophysics

Fall, Winter, Spring, Summer. 3 to 6 credits. Approval of department.

Reading course in special topics adapted to the individual preparation and needs of the student.

899. Master's Thesis Research

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

990. Biophysics Seminar

Fall, Winter, Spring, Summer. 1 credit. May reenroll for a maximum of 3 credits. Approval of department.

999. Doctoral Dissertation 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

201. Plants, People and the Environment (N)

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

Winter. 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.

301. Introductory Plant Physiology

Fall, Spring. 4(2-4) CEM 131 or CEM 141; CEM 161; BOT 205 or B S 210 or LBC 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

Fall, Winter. 4(2-4) 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(2-3) BOT 302 or B S 212 or approval of department.

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

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

Spring. 3(3-0)

Histories, characteristics, and origins of plants used in industrial processes, drug manufacture, and agriculture. Nontechnical to broaden student's cultural interest in plants.