E. Stuttering

*Summer. 4(3-0)*

Longitudinal studies of stuttering theories and the therapies accompanying them.

F. Cleft Palate

*Fall. 4(2-0)*

Etiology, symptomatology, structural and functional consideration of cleft palate. Therapeutic procedures for the speech habilitation of cleft palate individuals.

### 833. Specialized Clinical Audiology

A. Differential Audiometry

*Winter. 4(3-0)*

Pure tone audiometric tests as an aid to the otologist in evaluating the pathology of hearing loss; including the development of norms. Consideration of nonorganic loss.

B. Speech Audiometry and Evaluation of Hearing Aids

*Fall. 4(4-0)*

Speech audiometry; principles and methods in the selection of hearing aids; physical characteristics of hearing aids.

C. Industrial Audiology

*Summer. 4(2-2)*

Evaluation of the role of the audiologist in industry emphasizing identification procedures, damage-risk criteria, measurement and control of noise, conservation procedures, and medico-legal problems.

D. Advanced Audiological Evaluation

*Spring. 4(2-2)*

Theory, administration and evaluation of selected tests including Bekesy, EDR, EEG, and advanced speech-audiometric tests.

E. Pediatric Audiology

*Spring. 4(2-2)*

Evaluative procedures including play audiometry, language assessment, and case studies as aids to the differential diagnosis of auditory disorders in children; habilitative procedures for the acoustically handicapped child.

### 854. Psychophysics and Theories of Audition

*(854B.) Spring. 4(3-0)*

Nature of auditory stimuli and the results of psychophysical experimentation in audition.

### 874. Speech and Hearing Problems in Public Schools

*Summer. 4(3-0) May re-enroll for a maximum of 16 credits.*

Graduate seminar in speech and hearing involving problems that arise in relation to speech and hearing therapy in the public schools.

### 880A. Mathematical Measurement of Speech and Hearing Variables

*Fall. 4(4-0)*

Application of mathematical models in the analysis of hearing and speech processes.

### 880B. Acoustic Phonetics

*(875C.) Winter. 4(2-2) 880A or approval of department.*

An analytic study of the acoustics of speech.

### 880C. Instruments and Electronics for Audiology and Speech Sciences

*(875A.) Spring. 4(2-0) 880B or approval of department.*

A discussion of the electronic principles and instruments necessary to measure parameters related to hearing and speech processes.

### 880D. Experimental Phonetics

*(875B.) Summer. 4(2-0) 880C or approval of department.*

Critical review of the literature in experimental phonetics with special reference to the historical development of the field and subsequent experimentation in physiological and acoustical phonetics.

### 899. Research

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

### 940. Seminar in Audiology and Speech Sciences

*Spring, Summer. 4(2-0) May re-enroll for maximum of 16 credits.*

### 990. Special Problems in Audiology and Speech Sciences

*Fall, Winter, Spring, Summer. 1 to 6 credits.*

Special projects in audiology and speech sciences.

### 999. Research

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

## BIOCHEMISTRY BCH

**College of Agriculture and Natural Resources**
**College of Human Medicine**
**College of Natural Science**

### 200. Introduction to Biochemistry

*Winter, Summer. 5(5-0) General chemistry; one term organic chemistry. Not acceptable for a B.S. degree in biochemistry.*

Survey of biochemistry emphasizing the major metabolic activities of living organisms.

### 363. Clinical Biochemistry

*Spring. 3(2-3) 200; CEM 162. Primarily for Medical Technology majors; not acceptable for a B.S. degree in biochemistry.*

Quantitative clinical laboratory methods.

### 400H. Honors Work

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

Assigned reading and experimentation.

### 401. General Biochemistry I

*Fall, Spring. 5(5-0) One year organic chemistry or CEM 242.*

General biochemistry, emphasizing metabolism, structure and function of the major components of living cells.

### 402. General Biochemistry II

*Winter. 3(3-0) 401.*

Continuation of 401 with special emphasis on regulatory processes.

### 403. General Biochemistry III

*Spring. 2(2-0) 401; physical chemistry recommended.*

Continuation of 401 with special emphasis on enzymology.

### 404. General Biochemistry Laboratory I

*Fall, Winter, Spring. 3(1-6) Analytical chemistry; 401.*

Laboratory course based on the subject matter of 401.

### 478. Senior Seminar

*Fall, Winter, Spring. 0 or 1(1-0). May re-enroll for a maximum of 2 credits. Undergraduate biochemistry major or approval of department.*

Discussion, by undergraduate students and staff, of recent advances in biochemistry.

### 499. Research

*Fall, Winter, Spring, Summer. 1 to 4 credits. May re-enroll for a maximum of 12 credits. Approval of department.*

A course designed to give qualified undergraduate students an opportunity to gain experience in biochemical research.

### 801. Biochemical Research Methods

*Fall. 1(0-3) One year organic chemistry or CEM 242; 401 or concurrently.*

Discussions and demonstrations of selected experimental techniques of wide application in biochemistry.

### 802. Advanced Biochemistry I

*Winter. 3(3-0) 401, physical chemistry; advanced organic chemistry desirable.*

Physical biochemistry, enzyme structure and function.

### 803. Advanced Biochemistry II

*Spring. 3(3-0) 401, physical chemistry.*

Nucleic acids, protein biosynthesis, and regulatory mechanisms.

### 804. Advanced Biochemistry Laboratory I

*Fall. 3(1-6) Analytical chemistry; 801 concurrently; biochemistry majors or approval of department.*

Experiments to be selected from a representative group illustrating modern biochemical research.

### 805. Advanced Biochemistry Laboratory II

*Winter. 3(1-6) 802 concurrently; 804.*

Experiments to be selected from a representative group illustrating modern biochemical research.

### 806. Advanced Biochemistry Laboratory III

*Spring. 3(1-6) 805; 803 concurrently.*

Special experiments in advanced laboratory techniques.

### 855. Special Problems

*Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 12 credits. Approval of department.*

Consideration of current problems.

### 899. Research

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

### 960. Selected Topics in Biochemistry

*Fall, Winter, Spring, Summer. 1(1-0) or 2(2-0) May re-enroll for a maximum of 6 credits if a different topic is taken. Approval of department.*

Topics will be selected from the areas of biochemical genetics, biochemistry of development, biochemical evolution, complex proteins, lipid metabolism, immunochemistry, hormones, control mechanisms and structure of biological macromolecules.

### 961. Selected Topics in Biochemistry

*Fall, Winter, Spring, Summer. 1(1-0) or 2(2-0) May re-enroll for a maximum of 6 credits if a different topic is taken. Approval of department.*

Topics will be selected from the areas of bioenergetics, bioinstrumentation, complex carbohydrates, mechanisms of enzyme action, natural products, carbohydrate metabolism, mass spectrometry and biochemistry of isoprenoid compounds.

**978. *Seminar in Biochemistry***
*Fall, Winter, Spring. 0 or 1(1-0)*
Presentation and discussion of reports by graduate students on biochemical topics of current interest.

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

## BIOLOGICAL SCIENCE B S

### College of Natural Science

**202. *Foundations of Biological Science***
*Fall, Winter, Spring. 4(3-3) N S 193. Primarily for elementary education majors.*
Fundamental principles of biology.

**211. *General Biology***
*Fall, Winter, Spring. 5(4-3) Organic chemistry or concurrently.*
Integrated course emphasizing cell structure and function, genetics, comparative morphology and physiology of living organisms and their developmental and community relationships.

**212. *General Biology***
*Fall, Winter, Spring. 5(4-3) 211.*
Continuation of 211.

**401. *Biological Science for Teachers***
*Fall. 4(3-3) Bachelor's degree.*
Designed to show the nature of biological science in both its empirical and conceptual aspects. Emphasis is placed on life processes. The theories of the gene and of evolution are stressed. Macromorphology and micromorphology are covered as well as the topics of reproduction, metabolism, physiology, nutrition, enzymes, taxonomy and ecology. Quantitative developments are included whenever possible.

**402. *Biological Science for Teachers***
*Fall, Winter. 4(3-3) 401.*
Continuation of 401.

**403. *Biological Science for Teachers***
*Spring. 4(3-3) 402.*
Continuation of 402.

**410. *Biotic and Environmental Relationships***
*Summer. 6 credits. Approval of department. Given at W. K. Kellogg Biological Station.*
Interrelationship of the biota with its environment. Factors determining distribution and abundance. Interaction of organisms.

**420. *Seminar in Recent Advances in Biological Science***
*Fall, Winter, Spring, Summer. 3(3-0) May re-enroll 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.

**421. *Seminar on Man, "The Human Organism"***
*Fall, Winter, Spring, Summer. 3(3-0) Approval of department.*
The importance of new discoveries in biology for our understanding of the human organism with emphasis from the fields of genetics, molecular biology, behavior, developmental biology, physiology, and ecology.

**800. *Problems in Biological Science***
*Fall, Winter, Spring. Variable credit. B.S. degree in biological science.*

**999. *Research***
*Fall, Winter, Spring. Variable credit. M.S. degree in biological science or equivalent.*
Research in some phase of biological science, data to form the basis for the thesis required for the doctoral degree in biological science.

## BIOPHYSICS BPY

### College of Human Medicine
### College of Natural Science

**402. *Introduction to Biophysics***
*Spring. 5(5-0) PHY 259, MTH 113, 1 year organic chemistry and 1 year biology.*
Salient features of biophysics, methods and principles. Structure and organization of biological materials, bioenergetics, radiation biophysics, bioelectric phenomena, biomechanics and psychophysics.

**804. *Experimental Biophysics***
*Fall of odd-numbered years. 3 credits. Approval of department.*
Neuro-electric properties of cells, organs and animals, and methods of processing information in humans.

**805. *Experimental Biophysics***
*Winter of even-numbered years. 3 credits. Approval of department.*
Electrical and physical properties of significant biological molecules and structures.

**806. *Experimental Biophysics***
*Spring of even-numbered years. 3 credits. Approval of department.*
Interaction of protons and high energy particles with biological molecules and structures.

**811. *Principles of Biophysics***
*Fall of even-numbered years. 5(5-0) Approval of department.*
Intensive lecture course treating biophysical characterization of biological materials, quantum biology, information theory, properties of biological systems.

**812. *Principles of Biophysics***
*Winter of odd-numbered years. 5(5-0) Approval of department.*
Biophysical investigations of exciton theory, charge migration, radiation biophysics, primary photophysical processes in photosynthesis, surface chemistry and interfacial phenomena.

**813. *Principles of Biophysics***
*Spring of odd-numbered years. 5(5-0) Approval of department.*
Consideration of membrane characteristics, the initiation and propagation of bioelectrical signals, sensory mechanisms, information processing in humans, invertebrate and vertebrate central nervous system functions, psychophysics, and cybernetics.

**880. *Special Topics in Biophysics***
*Fall, Winter, Spring, Summer. Variable credit. May re-enroll 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.

**890. *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.

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

**990. *Biophysics Seminar***
*Fall, Winter, Spring, Summer. 1 credit. May re-enroll for a maximum of 3 credits. Approval of department.*

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

## BOTANY AND PLANT PATHOLOGY BOT

### College of Natural Science

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

**301. *Elementary Plant Physiology***
*Fall, Winter, Spring. 4(2-4) B S 212 or one course in botany. Not open to majors.*
Processes concerned in plant life.

**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.

**304. *Plant World***
*(432.) Fall, Winter, Spring, Summer. 4(2-6) N S 191 or approval of department.*
Basic plant science and its use in teaching. Lectures cover basic subject matter necessary to understanding plant kingdom, evidence and trends of evolution, economic uses and importances, basic principles of ecology. Laboratories give students opportunity to expand subject matter in one of several types of special projects: greenhouse, trees and shrubs, spring or summer flora, what plants do for man.

**305. *Poisonous Plants***
*Spring. 2(0-4) N S 193. Primarily for Veterinary Medicine students.*
Plants poisonous to livestock and human beings, particularly those occurring in Michigan.

**318. *Introductory Plant Taxonomy***
*Spring. 3(2-3) 302 or B S 212 or approval of department.*
Principles of identification, classification, nomenclature, and evolutionary relationships of vascular plants.

**336. *Economic Plants***
*Fall. 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.

**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, in wildlife management, and to role in limnology. Experience for student in plant ecology, aquatic biology, and water sanitation.