511. Medical Biochemistry I  
Winter. 3(3-0) One year of organic chemistry. Open only to students in the professional programs in the College of Human Medicine and the College of Osteopathic Medicine. 
Basic biochemical principles and terminology with emphasis on metabolism and function of biomolecules of importance in medical biology.

512. Medical Biochemistry II  
Spring. 4(4-0) BCH 511. 
Basic biochemical principles and processes pertinent to specific areas of human pathophysiology.

801. Biochemical Research Methods  
Fall. 1(1-1) or 2(2-1) May reenroll for a maximum of 2 credits. One year of organic chemistry or CEM 242; BCH 451 or BCH 811, or concurrently. 
Discussions and demonstrations of selected experimental techniques of wide application in biochemistry.

811. Advanced Biochemistry  
Fall. 4(4-0) One year of organic chemistry, one year of physical chemistry, one term of introductory biochemistry, BCH 801 taken previously or concurrently, or approval of department. Limited to graduate students in biochemistry or other students needing a similar professional preparation. 
The structure and function of biomolecules, energy transformations and chemical reactions in living cells, regulation of cell reactions, and the replication of living organisms.

821. Biochemical Mechanism and Structure  
Fall. 3(3-0) BCH 401, one year of organic chemistry and physical chemistry or concurrently, or approval of department. 
Structures, methods of structural analysis, synthesis, and reaction mechanisms of biological substances including proteins, carbohydrates, lipids, purines, pyrimidines, amino acids, and vitamins.

822. Biochemical Mechanism and Structure II  
Winter. 2(2-0) BCH 821 or approval of department. 
Continuation of BCH 821.

831. Physiological Biochemistry I  
Winter. 3(3-0) BCH 401. 
Physiological biochemistry, with emphasis on metabolic interpretation of normal and altered physiological states in the human organism and appropriate animal models.

832. Physiological Biochemistry II  
Spring. 3(3-0) BCH 831. 
Continuation of BCH 831.

855. Special Problems  
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 12 credits. Approval of department.

864. Plant Biochemistry  
Spring. 4(0-0) BCH 401, BOT 301 or approval of department. Interdepartmental with the Department of Botany and Plant Pathology. 
Metabolism of nitrogen-compounds, carbohydrates, and lipids unique to plants; cell organelles; photosynthesis; photoreception; dark respiration; cell walls; lectins; nitrogen cycle including nitrogen fixation; sulfur cycle.

888. Laboratory Rotation  
Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 15 credits. Graduating student majors; approval of department. 
Participation in research laboratories to learn experimental techniques and research approaches, broaden research experience, and assess research interests prior to selecting a thesis adviser.

899. Master's Thesis Research  
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

960. Selected Topics in Biochemistry  
Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 10 credits if different topics are taken. Approval of department. 
Topics will be selected from the areas of biochemical genetics, biochemistry of development, bio-mechanical evolution, complex proteins, lipid metabolism, immunology, hormones, control mechanisms and structure of biological macromolecules.

961. Selected Topics in Biochemistry  
Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 10 credits if different topics are taken. Approval of department. 
Topics will be selected from the areas of bioenergetics, biotechnological, 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. Doctoral Dissertation Research  
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

BIOLOGICAL SCIENCE B S

College of Natural Science  
The content of courses 400, 405, 420, and 440, as well as the research and problems courses 499, 890 and 899, may vary from term to term. Brochures giving detailed information about individual courses are available in the Science and Mathematics Teaching Center and the Office of the Assistant Dean for Lifelong Education. These courses are primarily designed for in-service teachers and interested adults and are offered off-campus locations.

202. Introductory Biology for Non-Science Majors  
Fall, Winter, Spring. 4(3-3) 12 credits in general education natural science courses. 
Concepts, procedures, and perspectives appropriate to developing a basic literacy in biology with emphasis on fundamental biological principles and their relation to world society. Appropriate preparation for pre-service elementary teachers.

400. Biological Science for Teachers  
Fall, Winter, Spring. 3 to 4 credits. May reenroll for a maximum of 12 credits. Teacher certification with science major or minor.

405. Topics in Biological Science  
Fall, Winter, Spring. 1 to 3 credits. May reenroll for a maximum of 6 credits if different topic is taken. Approval of department. 
Presentation of single topics from the biological sciences by senior faculty and guest lecturers. Topics are selected to facilitate development of strong biological science programs in schools.

408. Freshwater Ecology  
Summer. 6 credits. B S 212 or approval of department. Given at W. K. Kellogg Biological Station. Interdepartmental with the departments of Zoology, and Botany and Plant Pathology.

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. Interdepartmental with the departments of Botany and Plant Pathology, and Zoology.

Extensive field investigations of several types of terrestrial communities. Interrelationship of plants, animals, and environment. Factors determining distribution and abundance.
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 on topics on the history, development, most recent advances and the possible future and limits of the Biological Sciences.

422. Terrestrial Field Biology for Teachers
Summer. 3 credits. 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.

423. Aquatic Field Biology for Teachers
Summer of even-numbered years. 3 credits. 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. 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 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 6 credits if different topics are taken. B.S 422 or B S 425 or ZCL 400 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.

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.

581. 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 6 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 6.
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.

850. 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.

BIOPHYSICS

BPY

College of Human Medicine
College of Natural Science

4001. Honors Work in Biophysics
Fall, Winter, Spring, Summer. 3 to 6 credits. May reenroll for a maximum of 9 credits. Approval of department.
Independent study and investigation under the supervision of a member of the Biomedical Engineering Committee.

BIOENGINEERING

BME

College of Engineering

410. Electronic Instrumentation in Biology and Medicine
Fall, Winter, Spring. 4 to 6 credits. MTH 112, PHY 238 or approval of instructor.
Electronic components and circuits. Physiological measurements. Transduction of physiological events to electrical signals. Detection of pathological 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 to 6 credits. PHY 288.

414. Clinical Instrumentation
Winter of even-numbered years. 3(3-0)
BME 410.

424. Materials in Biomedical Engineering
Winter. 3(3-0) PSL 240 or PSL 431 or approval of department.

431. Biological Transport Mechanisms
Spring. 3(3-0) MTH 215.
Mechanisms which govern transport or movement, heat and mass. Application to mathematical description of transport processes in biological systems and to the solution of biomedical problems.

451. Tissue Biomechanics
Fall, Winter, Spring, Summer. 1 to 4 credits. 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.

MTH 288, PHY 238, ZCL 400, ZCL 422, or approval of department.

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