BIOCHEMISTRY

BIOCH 433, 633 General Biochemistry Laboratory I 2(0,4) Experiments to illustrate current methods used in biochemical research. Preq: Concurrent enrollment in BIO CH 423 or 431.

BIOCH 434, 634 General Biochemistry Laboratory II 2(0,4) Continuation of BIO CH 433. Preq: Concurrent enrollment in BIO CH 432.

BIOCH 436, 636 Nucleic Acid and Protein Bio-synthesis 3(3,0) Examines how nucleic acids and proteins are synthesized in prokaryotic and eukaryotic cells. Designed for students interested in biochemistry, cell biology, molecular biology, and cell physiology. Preq: BIO CH 423, 431, or 432, or consent of instructor.

BIOCH 443, 643 Biochemical Basis of Disease 3(3,0) Topics in heritable human metabolic disorders including clinical features and newborn screening, genetic testing, the biochemical basis, and treatment. Preq: GEN 302, BIO CH 301, or consent of instructor.

BIOCH 490 Selected Topics in Biochemistry 1-4(0-4,0) Comprehensive study of selected topics not covered in other courses. May be repeated for a maximum of eight credits, but only if different topics are covered. Preq: Junior standing or consent of instructor.

BIOCH 491, 491 Special Problems in Biochemistry 1-8(0,3-24) Orientation in biochemical research (i.e., experimental planning, execution, and reporting). May be repeated for a maximum of eight credits.

BIOCH (GEN) 493, 493 Senior Seminar 2(2,0) A synthesis and discussion of papers from the primary literature in the life sciences particularly in biochemistry. Students select pertinent articles in the primary literature and present and analyze the selected reading.

BIOENGINEERING

BIOE 201 Organs and Their Replacements 3(3,0) Provides engineering, biological, and physical science students with an overview of the replacement of human body parts and the problems related to artificial devices. Offered fall semester only.

BIOE 302 Biomaterials 3(3,0) Study of metallic, ceramic, and polymer materials used for surgical and dental implants; materials selection, implant design, physical and mechanical testing; corrosion and wear in the body. In addition, physical and mechanical properties of tissue as related to microstructure are studied. Offered spring semester only. Preq: C M E 210 or consent of instructor.

BIOE 320 Biomechanics 3(3,0) Study of relation between biological and mechanical functions of musculoskeletal tissues such as bone, ligaments, muscles, cartilage, etc.; mechanics of human joints; analysis of implants and implant failure. Preq or Coreq: M E 302 or consent of instructor.

BIOE 401 Biomedical Design 3(3,0) Covers basic steps in designing medical devices intended for short- or long-term implantation. Materials selection, fabrication processes, performance standards, cost analysis, and design optimization are covered. Design project is required. Preq: BIO E 302, 320, M E 302; engineering major.

BIOE 420 Sports Engineering 3(3,0) Study of engineering principles involved in sports body systems in human motion, analysis of gait, basic performance patterns in athletic movements, performance improvements, design of sports equipment. Preq: BIO E 302 and 320 or consent of instructor.

BIOE 450, H 450 Special Topics in Bioengineering 1-4(1-4,0) Comprehensive study of a topic of current interest in the field of biomedical engineering under the direct supervision and guidance of a faculty member. May be repeated for a maximum of six credits, but only if different topics are covered. Preq: Consent of instructor.

BIOE 470 Bioinstrumentation 3(3,0) Introduction of fundamental topics in bioinstrumentation focused on acquiring and monitoring of vital signals. Basic principles for the selection and appropriate use of instruments for solving bioengineering and medical problems such as radiography, computerized tomography, magnetic resonance imaging, and ultrasounds, among others, are addressed. Preq: MTHSC 206, PHY S 221, or consent of instructor.

BIOE (C M E) 480, 680 Research Principles and Concepts 1(1,0) Introduces seniors and graduate students to principles and practices of scientific research. Topics include developing scientific concepts, developing projects, pursuing research, collaborating in multidisciplinary teams, patenting and publishing technical and scientific information, and reviewing professional and ethical standards of performance. To be taken Pass/Fail only.

BIOLOGICAL SCIENCES

BIO 423, 623 Principles of Biochemistry 3(3,0) Study of the chemistry of amino acids, monosaccharides, fatty acids, purines, pyrimidines, and associated compounds leading to an understanding of their properties and the relationship between structure and function that makes them important in biological processes. The use of modern techniques is stressed. Preq: CH 224 or equivalent.

BIO 431, H 431, 631 Physical Approach to Biochemistry 3(3,0) Study of chemical and physical properties of amino acids, lipids, nucleic acids, sugars, and their biopolymers. Physical and mathematical analyses are correlated with biological structure and function. Preq: BIO CH 301 with a C or better or consent of instructor. Coreq: Physical chemistry.

BIO 432, H 432, 632 Biochemistry of Metabolism 3(3,0) Study of the central pathway of carbohydrate, lipid, and nucleotide metabolism. Bioenergetics, limiting reactions, and the regulation and integration of the metabolic pathways are emphasized. Preq: BIO CH 423 or 431 or consent of instructor.

MTHSC 206, PHYS 221, or consent of instructor.
Courses of Instruction

Topics include ecology, evolution, behavior, and organismal biology. Preq: BIOL 103 or 110 or consent of course coordinator.

**BIOC 200 Biology in the News 3(3,0)** For non-science majors. Students examine current topics of biology appearing in newspapers and other current media. Uses a problem-based learning approach, with students working as teams and individually on areas of interest identified by the class. Preq: ENGL 103, General Education Natural Science Requirement.

**BIOC 205 Plant Form and Function 3(3,0)** An introductory course for students majoring in plant sciences. Integrates lecture and laboratory and emphasizes fundamental structures and functions of higher plants. Preq: BIOL 103 or consent of instructor.

**BIOC 206 Plant Form and Function Laboratory 1(0,3)** Laboratory for BIOC 205. Preq or Coreq: BIOC 205 or consent of instructor.

**BIOC 210 Introduction to Toxicology 3(3,0)** acquaints students with the field of toxicology, integrates the science of toxicology with regulatory policy, and demonstrates its impact on our daily lives. Preq: BIOL 103, 110, or consent of instructor.

**BIOC 222 Human Anatomy and Physiology I 4(3,2)** Basic introductory course in integrated human anatomy and physiology covering cells and tissues; integumentary, skeletal, muscular, and nervous systems; sensory organs. Physiology is stressed. Structured primarily for Nursing and other health-related curricula. Preq: BIOL 103 or 110; CH 101 and 102, or 105 and 106.

**BIOC 223 Human Anatomy and Physiology II 4(3,2)** Continuation of BIOC 222 covering endocrine, reproductive, cardiovascular, lymphatic, respiratory, urinary, and digestive systems; fluid and electrolyte balance. Physiology is stressed. Preq: BIOC 222 or consent of instructor.

**BIOC (ENT) 301 Insect Biology and Diversity 4(3,3)** See ENT 301.

**BIOC 302, H302 Invertebrate Biology 3(3,0)** In-depth survey and comparison of free-living invertebrate animals emphasizing functional anatomy, development, and evolutionary relationships. Preq: Introductory two-semester biology sequence with laboratory. Coreq: BIOC 306.

**BIOC 303, H303 Vertebrate Biology 3(3,0)** Comprehensive survey of vertebrate animals including their taxonomy, morphology, evolution, and selected aspects of the natural history and behavior. Preq: Introductory two-semester biology sequence with laboratory.

**BIOC 304, H304 Biology of Plants 3(3,0)** Survey of the major groups of plants, their biology, diversity, and evolution. Preq: BIOL 104 or 111 or BIOC 205.

**BIOC 305, H305 Biology of Algae and Fungi 3(3,0)** Introduction to the biology of the major groups of algae and fungi. Emphasizes how select representatives of the algae and fungi are adapted to their environment through structural, physiological, and life-cycle modifications. Preq: BIOL 104 or 111 or BIOC 205.

**BIOC 306 Invertebrate Biology Laboratory 1(0,3)** Survey and comparison of the biology of living invertebrates, examples of which are drawn primarily from the southeastern coast of the United States. Preq: Introductory two-semester biology sequence with laboratory. Coreq: BIOC 302.

**BIOC 307 Vertebrate Biology Laboratory 1(0,3)** Comparative and phylogenetic study of the gross morphology of vertebrates. Preq or Coreq: BIOC 303.

**BIOC 308 Biology of Plants Practicum 1(0,3)** Laboratory exercises that explore the major groups of plants, their biology, diversity, and evolution. Preq or Coreq: BIOC 304.

**BIOC 309 Algae/Fungi Practicum 1(0,3)** Practice in the manipulation and examination of selected algae and fungi, with emphasis on culture techniques and examination of the structure and adaptations of the algae and fungi to different environments. Preq or Coreq: BIOC 305.

**BIOC (W F B) 313 Conservation Biology 3(3,0)** See W F B 313.

**BIOC 315 Functional Human Anatomy 4(3,3)** Introduction to the anatomical structures associated with all organ systems found in the human body at both the gross and microscopic level. Basic physiology is integrated into the course to assist with understanding the function of the anatomical systems. Preq: BIOL 103 or 110.

**BIOC 320 Field Botany 4(2,4)** Introductory study of the taxonomy, ecology, and evolution of plants in their natural environment with an emphasis on identification and characteristics of representative species and plant communities in the Carolinas. Includes one or two required Saturday field trips. Preq: BIOL 104, 111, or BIOC 205, or consent of instructor.

**BIOC 335 Evolutionary Biology 3(3,0)** Introduction to basic concepts and underlying principles of modern evolutionary biology. Topics include a historical overview of evolutionary theories, elementary population genetics, principles of adaptation, speciation, systematics and phylogenetic inference, fossil record, biogeography, molecular evolution, and human evolution. Preq: GEN 302 or equivalent.

**BIOC (PL PH) 340 Plant Medicine and Magic 3(3,0)** See PL PH 340.

**BIOC (ENT) 400, H400, 600 Insect Morphology 4(3,3)** See ENT 400.

**BIOC 401, H401, 601 Plant Physiology 3(3,0)** Relations and processes pertaining to maintenance, growth, and reproduction of plants, including absorption of matter and energy, water relations of the plant, utilization of reserve products and liberation of energy. Preq: BIOL 104 or 111 or BIOC 205 and CH 102. Coreq: BIOC 402.

**BIOC 402, H402, 602 Plant Physiology Laboratory 1(0,3)** Laboratory exercises and experiments designed to indicate the relations and processes which pertain to maintenance, growth, and reproduction of plants, including absorption of matter and energy, water relations of the plant, utilization of reserve products, and liberation of energy. Coreq: BIOC 401.

**BIOC 403, H403, 603 Protozoology 3(3,0)** Survey of the protozoa with emphasis on organization and function. Representative types of both free-living and parasitic forms are examined for each major taxon. Preq: BIOL 104 or 111.

**BIOC 404, H404, 604 Protozoology Laboratory 2(1,2)** Laboratory exercises reinforce the material presented in BIOC 403 and introduce students to techniques used in collection, preservation, and examination of protozoans. Coreq: BIOC 403.

**BIOC (GEN) 405, H405, 605 Molecular Genetics of Eukaryotes 3(3,0)** See GEN 405.

**BIOC 406, H406, 606 Introductory Plant Taxonomy 3(3,0)** Introduction to the basic principles and concepts of plant systematics with emphasis on the plants of South Carolina. Preq: BIOL 104 or 111 or BIOC 205. Coreq: BIOC 407.

**BIOC 407, H407 Plant Taxonomy Laboratory 1(0,3)** Introduction to basic techniques of plant taxonomy with laboratory and field emphasis on the flora of South Carolina. Coreq: BIOC 406.

**BIOC 408, H408, 608 Comparative Vertebrate Morphology 3(3,0)** Phylogeny and diversity of vertebrates and study of their comparative morphology, leading to an understanding of the relationships and functioning of living organisms. Preq: BIOL 104 or 111. Coreq: BIOC 409.

**BIOC 409, H409, 609 Comparative Vertebrate Morphology Laboratory 2(0,5)** Comparative anatomy of representative vertebrates; methods used in preparing specimens for study and display. Coreq: BIOC 408.

**BIOC 410, 610 Limnology 3(3,0)** Detailed introduction to the physical, chemical, and biological interrelationships that characterize inland water environments. A fundamental approach to the interactions of components of the environment is developed at a theoretical level. Preq: Junior standing in a life science or consent of instructor.

**BIOC 411, H411, 611 Limnological Analyses 2(1,2)** Examines a broad range of topics covered with both standing and running fresh waters. A bout one-third of the laboratory exercises address the major physical components of lakes and streams. The remainder provides rationale and methods for quantitative analyses of biota, as well as some integrated analyses of whole ecosystems. Preq or Coreq: BIOC 410 or 443.

**BIOC (E N R) 413, 613 Restoration Ecology 3(3,0)** See E N R 413.

**BIOC (AVS, MICRO) 414, H414, 614 Basic Immunology 4(3,3)** See MICRO 414.

**BIOC (ENT) 415, 615 Insect Taxonomy 3(1,6)** See ENT 415.

**BIOC (GEN) 416, 616 Recombinant DNA 3(3,0)** See GEN 416.

**BIOC 417, 617 Marine Biology 3(3,0)** Survey of the organisms that live in the sea and their adaptations to the marine environment. Characteristics of marine habitats, organisms, and the ecosystems are emphasized. Preq: BIOL 104, 111, or consent of instructor.

**BIOC (GEN, MICRO) 418, 618 Biotechnology I: Nucleic Acids Techniques 4(2,4)** See GEN 418.

**BIOC 420, H420, 620 Neurobiology 3(3,0)**
Broad background in neurobiology. Topics include neuroanatomical structure-function; conduction in the neuron; neurite growth and development; neuromuscular junction; chemistry, physiology, and pharmacology of specific neurotransmitters and receptors; visual process; axoplasmic transport; hypothalamic-pituitary regulation; theories of behavior; theories of learning and memory. Prereq: BIOCH 301 or 305 or consent of instructor.

BIOSC 425, 625 Introductory Mycology 3(3,0)
Introduction to the biology of all the groups of fungi and some related organisms, with considerations of the taxonomy, morphology, development, physiology, and ecology of representative forms. Prereq: BIOL 104 or 111 or BIOC 205.

BIOSC 426, 626 Mycology Practicum 2(1,2)
A practical application of the principles of mycological techniques, including isolation, culture, identification, and microscopic study of fungi. Examples from all major groups of fungi are included. Prereq or Coreq: BIOC 425.

BIOSC (ENT) 430, 630 Toxology 3(3,0) See ENT TOX 430.
BIOSC 432, H432, A nimal H istology 3(3,0)
Structural and functional study of the basic tissues of animals and tissue makeup of organs. Emphasis is on light microscopy level with selected tissue studied at the electron microscope level. Prereq: BIOC 303 or consent of instructor. Coreq: BIOC 433.

BIOSC 433, H433, A nimal H istology Labo ratory 2(1,2)
Microscopic examination of basic animal tissue types and the tissue makeup of organs which comprise systems. Coreq: BIOC 432.

BIOSC (ENT) 436, 636 Insect B ehavior 2(2,3) See ENT 436.
BIOSC 440, H440, 640 Developmental A nimal B iology 3(3,0) Events and mechanisms responsible for the development of multicellular animals. Gametogenesis, fertilization, embryonic development, cellular differentiation, morphogenesis, larval forms and metamorphosis, asexual reproduction, regeneration, malignancy, and aging are analyzed in terms of fundamental concepts and control processes. Prereq: BIOCH 301 or 305 or consent of instructor. Coreq: BIOC 450.

BIOSC 441, H441, 641 Ecol ogy 3(3,0)
Study of basic ecological principles underlying the relationships between organisms and their biotic and abiotic environments. Includes physiological, population, and community ecology, with applications of each to human ecological concerns. Prereq: BIOL 104, 111, BIOC 205, or consent of instructor.

BIOSC 442, H442, 642 B iogeography 3(3,0)
Study of patterns of distribution of plants and animals in space and time. Prereq: BIOC 302 or 303 or 304 or 305 or consent of instructor.

BIOSC 443, H443, A quatic Ecol ogy 3(3,0)
Study of basic ecological principles and concepts as they apply to aquatic environments: rivers and streams, lakes and ponds, reservoirs, swamps, marshes, estuaries, and marine systems. Prereq: Junior standing in a life science or consent of instructor.

BIOSC 445, H445, 645 Ecology Laboratory 2(1,2) Modern and classical approaches to the study of ecological problems discussed in BIOSC 441. Students are introduced to field, laboratory, and computer-based analyses of plant and animal populations and communities. Prereq or Coreq: BIOSC 441.

BIOSC 446, H446, 646 Plant Ecology 3(3,0)
Ecology of plants in relation to their biotic and abiotic environments. Individual organisms, populations, and communities are considered with an emphasis on seed plants in terrestrial environments. Prereq: BIOL 104, 111, BIOC 205, or consent of instructor.

BIOSC 447, H447, 647 Plant Ecology Laboratory 2(1,2) Experimental and observational approach to addressing principles discussed in BIOSC 446. Students are introduced to field and laboratory methods involving individual organisms, populations, and communities. Prereq or Coreq: BIOSC 444 or consent of instructor.

BIOSC 450, 450, 650 Developmental Biology Laboratory 2(1,2) Examines a broad range of topics concerned with the development of multicellular animals such as gametogenesis, fertilization, embryonic development, cell differentiation, morphogenesis, larval metamorphosis, and regeneration. Laboratory exercises provide the rationale and methods for the descriptive and experimental analysis of development in representative invertebrates and vertebrates. Prereq or Coreq: BIOSC 440 or equivalent.

BIOSC 452, 652 Plant Anatomy and Morphology 3(3,0) Study of the anatomy, reproduction, and phylogenetic relationships of vascular plants. Prereq: BIOL 104, 111, BIOC 205, or consent of instructor.

BIOSC 453, 653 Plant Anatomy and Morphology Laboratory 2(1,2) Laboratory focusing on the anatomy, reproduction, and phylogenetic relationships of vascular plants. Coreq: BIOSC 452.

BIOSC 454, 654 Plant Virology 4(3,3) Study of plant viruses: their morphology, biochemistry, purification, and transmission; symptoms resulting from virus infection; virus-vector relationships. Se- rological and nucleic acid hybridization procedures. Diagnosis of viral diseases and the identification of causal agents. Replication of plant viruses, the interaction between viral host and plant genome. Control of plant viral diseases. Prereq: BIOL 301, MICRO 305, or consent of instructor.

BIOSC (ENT) 455, 655 Medical and Veterinary Entomology 3(2,3) See ENT 455.

BIOSC 456, 456, 656 Medical and Veterinary Parasitology 3(3,0) Introduction to parasitism in the animal kingdom; emphasizes basic and applied principles related to economically and medically important diseases. Classical and experimental approaches to the study of parasitism are examined in reference to protozoa, helminths, and arthropods. Prereq: BIOL 104 or 111. Coreq: BIOSC 457.

BIOSC 457, H457, 657 Medical and Veterinary Parasitology Laboratory 2(1,2) Laboratory to reinforce material presented in BIOSC 456. Introduces students to both live and preserved human/animal parasites. Aiso introduces techniques used in collection, preservation, and examination of animal parasites. Coreq: BIOSC 446.

BIOSC 458, H458, 658 Cell Physiology 3(3,0) Study of the chemical and physical principles of cell function emphasizing bioenergetics and membrane phenomena. Prereq: BIOCH 301 or 305 or consent of instructor.

BIOSC 459, 459, 659 Systems Physiology 3(3,0) Physiological systems of vertebrates and their homeostatic controls. Function of the major physiological systems is described in terms of anatomical structure and chemical and physical principles. Prereq: One year each of biology, chemistry, and physics or consent of instructor.

BIOSC 460, 660 Systems Physiology Laboratory 2(1,2) Modern and classical experimental methods are used to demonstrate fundamental physiological principles discussed in BIOSC 459. Students are introduced to computer-aided data acquisition and computer simulations of physiological function. Prereq or Coreq: BIOSC 459.

BIOSC 461, 461, 661 Cell Biology 3(3,0) In-depth analysis of how and where intracellular and extracellular molecules control general and specific cellular functions such as gene expression, secretion, motility, signaling, cell-cycle control and differentiation. Taught and graded at a level where students are expected to learn and integrate cellular events. Prereq: BIOCH 301 or consent of instructor.

BIOSC 462, 662 Cell Biology Laboratory 2(1,2) A companies BIOSC 461, focuses on molecular and microscopic analysis of eukaryotic cells. Coreq: BIOSC 461.

BIOSC 464, 664 Mammalogy 3(2,3) Origin, evolution, distribution, structure, and function of mammals with laboratory emphasis on the mammals of South Carolina. Field collection required. Prereq: BIOSC 303 or consent of instructor.

BIOSC (GEN, HORT) 465, 665 Plant Molecular Biology 3(3,0) See HORT 465.

BIOSC 468, 668 Herpetology 3(2,3) Systematics, life history, distribution, ecology, and current literature of amphibians and reptiles. Laboratory study of morphology and identification of world families and U.S. genera, as well as all southeastern species. Field trips are required. Prereq: BIOSC 303 or consent of instructor.

BIOSC (ENT, WFB) 469, H469, 669 A quatic Insects 3(1,6) See ENT 469.

BIOSC 470, 470, 670 A nimal B ehavior 3(3,0) Historical and modern developments in animal behavior emphasizing the evolutionary and ecological determinants of behavior. A synthesis of ethology and comparative psychology. Prereq: BIOSC 302 or 303 or consent of instructor.

BIOSC 471, 671 Animal Behavior Laboratory 1(0,3) Laboratory exercises that explore the behavior of animals. Emphasis is on behavioral observation and analysis and presentation of findings in a report format. Prereq or Coreq: BIOSC 470 or consent of instructor.

BIOSC 472, 672 Ornithology 4(3,3) Biology of
BIOSC 493 Senior Seminar 2(0,0)
BIOSC (AVS) 480, 680 Vertebrate Endocrinology
BIOSC 477, 677 Ichthyology 3(2,3)
BIOSC 490 Selected Topics in Biological Sciences

Courses of Instruction

Technical and non-technical literature in biological sciences to provide an introduction to research planning and techniques. Selected areas of biological sciences to provide an introduction to research planning and techniques. May be repeated for a maximum of eight credits, but only if different topics are covered. Preq: BIOSC 493 or consent of instructor.

BIOSC 475, H 475, 675 Comparative Physiology 3(3,0) Physiological systems of invertebrates and vertebrates with emphasis on environmental adaptation. Physiological principles as they relate to metabolism, thermoregulation, osmoregulation, respiration, and neural integrative physiology. Prep: One year each of biology, chemistry, and physics or consent of instructor.

BIOSC 476, H 476, 676 Comparative Physiology Laboratory 2(1,2) Modern classical experimental methods are used to demonstrate fundamental physiological principles discussed in BIOSC 475. Students are introduced to computer-aided data acquisition and manipulation as well as computer simulations of physiological function. Preq or Coreq: BIOSC 475.

BIOSC 477, 677 Ichthyology 3(2,3) Systematics, life history, distribution, ecology, and current literature of fish. Laboratory study of morphology and identification of U.S. genera, as well as all southeastern species. Field trips are required. Preq: BIOSC 475 or consent of instructor.

BIOSC (AVS) 480, 680 Vertebrate Endocrinology 3(3,0) Introduction to the basic principles of neuro-endocrine integration and homeostatic maintenance in vertebrates. Comparative morphology and physiology of various endocrine tissues and hormone chemistry and modes of action are considered. Preq: BIOSC 475, organic chemistry, or consent of instructor.

BIOSC 486 Natural History 3(3,0) Interdisciplinary examination, through readings and critical discussion, of concepts of nature and biodiversity in relation to human endeavors. Course seeks to achieve a balanced perspective from which to seek compromises between conflicting views of nature. Preq: BIOSC 441, 443, or 446, or equivalent, or consent of instructor.

BIOSC 490 Selected Topics in Biological Sciences 1-4(1-4,0-9) Comprehensive study of selected topics not covered in other courses. May be repeated for a maximum of eight credits, but only if different topics are covered. Preq: Junior standing or consent of instructor.

BIOSC 491, H 491 Special Problems in Biological Sciences 2-4(0,6-12) Research problems in selected areas of biological sciences to provide an introduction to research planning and techniques. May be taken for a maximum of eight credits. Preq: Junior standing or consent of instructor.

BIOSC (MICR O) 493 Senior Seminar 2(2,0) A seminar and discussion of publications from the technical and non-technical literature in biological sciences and from current topics of biology appearing in other media. Students complete their undergraduate on-line e-portfolios, which were initiated in BIOSC 101. Emphasis is placed on ethical issues that arise as a result of biological research. Preq: Senior standing; COMM 150 or ENGL 314; or consent of instructor.

BIOSCIENCE

BIOL 103, H 103 General Biology I 4(3,3) First in a two-semester sequence on the fundamentals of biology. Lecture and laboratory emphasize the structural, molecular, and energetic basis of cellular activities, fundamentals of genetic variability, reproductive strategies of organisms, and scientific processes. Diversity of animals and principles of evolution are introduced. Credit toward a degree will be given for only one of the following combinations: BIOL 110/111 or 103/104, dependent on the requirements for the major.

BIOL 104, H 104 General Biology II 4(3,3) Continuation of BIOL 103, emphasizing animals and plants as functional units, evolution and diversity of plants, and principles of evolution and ecology. Credit toward a degree will be given for only one of the following combinations: BIOL 110/111 or 103/104, dependent on the requirements for the major. Preq: BIOL 103.

BIOL 109 Introduction to Life Science 4(3,3) Survey of topics in botany, zoology, microbiology, and ecology emphasizing comprehension and practical application of life-science concepts to experiments and activities for the elementary school classroom. Enrollment priority will be given to Early Childhood and Elementary Education majors.

BIOL 110, H 110 Principles of Biology I 5(4,3) Introductory course designed for students majoring in biological disciplines. Integrates lecture and laboratory and emphasizes a modern, quantitative, and experimental approach to explanations of structure, composition, dynamics, interactions, and evolution of cells and organisms. High school chemistry is recommended. Credit toward a degree will be given for only one of the following combinations: BIOL 110/111 or 103/104, dependent on the requirements for the major. Coreq: CH 101.

BIOL 111, H 111 Principles of Biology II 5(4,3) Continuation of BIOL 110; emphasizes the study of plants and animals as functional organisms and the principles of ecology. Credit toward a degree will be given for only one of the following combinations: BIOL 110/111 or 103/104, dependent on the requirements for the major. Preq: BIOL 110.

BIOL 120 Biological Inquiry Laboratory 1(0,3) Required laboratory experience to accompany BIOL 121, 122, or 123. Focus is on the process and outcomes of scientific inquiry. Students employ scientific methodology in a laboratory environment as well as critical analysis of biological problems in a small group context. Coreq: BIOL 121, 122, or 123.

BIOL 121 Keys to Human Identity 3(3,0) Introduction to scientific inquiry that emphasizes the biological aspects of human identity, including genetics, development, and the brain. A pliplication in biotechnology and ethical issues associated with these topics are discussed. The role of evolution in determining patterns of unity and diversity among living organisms is a unifying theme. Coreq: BIOL 120.

BIOL 122 Keys to Biodiversity 3(3,0) Introduction to scientific inquiry through analysis of the topic of biodiversity. Biological foundations for life are studied, including how evolution shapes patterns of unity and diversity among organisms and the environment. Also included is focused discussion of human influences on the living world and associated ethical issues. Coreq: BIOL 120.

BIOL 123 Keys to Human Biology 3(3,0) Introduction to scientific inquiry through focused analysis on human biology. Consideration is given to biological processes that occur within humans as well as human impact on global biological processes. Interrelationships with non-human organisms that ultimately affect evolution and diversity of life are explored. Coreq: BIOL 120.

BIOL 201 Biotechnology and Society 3(3,0) Introduction to the theories, fields, and applications of biotechnology, including the structure and function of genes and their manipulation to improve plant and animal productivity and human health. Individual case studies are examined including social and ethical issues surrounding biotechnology-based research and development. Not open to Genetics majors. Preq: BIOL 120 and 121, 122, or 123, or equivalent, or consent of the instructor.

BIOL 203 Human Disease and Society 3(3,0) Focuses on the basic biology underlying human disease, how disease is understood, and current methods of prevention and treatment of disease. The economics as well as the social and ethical issues surrounding human disease are a common thread throughout the course. Preq: BIOL 104; 121, 122, or 123; or consent of the instructor.

BIOL 210 Evolution and Creationism 3(3,0) Critical review of the scientific and technological basis for evolutionary theory compared to creationist explanations for the origin and diversity of life. Includes a historical survey of the impact that the evolution/creation debate has had on law, politics, education, and other important aspects of society. Preq: BIOL 104; 111; 121, 122, or 123; or consent of instructor.

BIOSYSTEMS ENGINEERING

Professors: W. H. A. Iliin, Chair; D. E. Brune, R. B. Dodd, Y. J. Han; A. associate Professors: J. P. Chastain, C. M. Drapcho, C. V. Privette, T. H. Walker; Assistant: T. O. Owingo; Instructor: K. R. Kirk

B E 210 Introduction to Biosystems Engineering 2(1,3) Overview of topics and engineering application areas that comprise the Biosystems Engineering profession. Significant emphasis is also given to development of oral and written communication skills needed by the engineering professional, introduction to design methodology, and application of engineering fundamentals to biological systems. Preq: ENGR 130, MTH SC 106.

B E 212 Fundamentals of Biosystems Engineering 2(1,3) Introduction to fundamental concepts in biosystems engineering, including mass, energy, and momentum balances; mass, heat, and momentum transfer; biological response to environmental variables, biological materials, biological kinetics, and techniques of measurement and analysis of engineering and biological data. Laboratory includes hands-on exercises, problem solving and computer
B E 222 G E o m e a s u r e m e n t s 2 ( 1 , 3 ) Fundamentals of land measurement and traverse calculations. Leveling, earthwork, area, and topographic measurements using levels, total stations, and GPS. A mapping of application via GIS. Preq: M TH SC 106.
B E H 300 Biosystems Engineering Honor Seminar 0 ( 0 , 1 ) Introduces undergraduate students to current faculty research. Project ideas are then developed to prepare students in choosing a research topic for the senior honors thesis. Students are required to attend senior honors thesis presentations. To be taken Pass/Fail only. Preq: Junior standing in departmental honors program.
B E 312 B i o l o g i c a l K i n e t i c s a n d R e a c t o r M o d e l i n g 3 ( 2 , 3 ) Fundamentals of microbial and biochemical kinetics used in analysis and design of biological systems. Topics include mathematical and computer modeling of microbial kinetics and systems, estimating model coefficients, and development of microbial kinetic models as basis for batch and continuous reactor design. Preq: B E 212, M TH SC 208.
B E 314 B i o s y s t e m s E n g i n e e r i n g M e c h a n i c a l D e s i g n 3 ( 3 , 0 ) Basic mechanical design of biosystems; introduction to biomechanics and biomaterial properties; applications of machine components and their selection related to specific types of biosystems; team design project. Preq: C E 206 or M E 302.
B E 322 S m a l l W a t e r s h e d H y d r o l o g y a n d S e d i m e n t o l o g y 3 ( 3 , 0 ) Fundamental relationships governing rainfall disposition are used as bases for defining the hydrology of watersheds. A. Application of modeling techniques appropriate for runoff and sediment control is emphasized. Preq: PHYS 122. Co: C E 312.
B E 370 P r a c t i c u m 1 - 3 Preplanned internship with an approved employer involved with biosystems engineering endeavors. A minimum 130 hours of supervised responsibility is required per credit hour. Evaluation is based on activity journal, written/oral report, and an evaluation from the supervisor. May be repeated for a maximum of six credits. To be taken Pass/Fail only. Preq: Junior standing and departmental consent.
B E H 400 B i o s y s t e m s E n g i n e e r i n g H o n o r s U n d e r g r a d u a t e Research 1 - 3 ( 0 , 2 - 6 ) Individual research projects conducted under the supervision and guidance of a faculty member. Senior honors thesis is required. May be repeated for a maximum of six credits. Preq: B E H 300 and consent of instructor.
B E ( C S E N V ) 4 0 8 , 4 0 8 L a n d T r e a t m e n t of W a t e s t a w e r a n d S l u d g e s 3 ( 3 , 0 ) See C S E N V 408.
B E 412, 612 H e a t a n d M a s s T r a n s p o r t i n B i o s y s t e m s Engineering 3 ( 3 , 0 ) Fundamentals of heat and mass transport used in engineering design and analysis of biological systems; principles of steady state and transient energy and mass balances including chemical and biological generation terms. Preq: B E 312, M TH SC 208. Co: M E 310.
B E 414, 614 B i o s y s t e m s E n g i n e e r i n g U n i t O p e r a t i o n s 3 ( 2 , 3 ) Applies the basic principles of statics, dynamics, and thermodynamics to design of mechanical and electrical systems supporting biological operations and processes. Preq: B E 314, M E 310.
B E 415, H 415, 615 I n s t r u m e n t a t i o n a n d C o n t r o l f o r B i o s y s t e m s E n g i n e e r i n g 4 ( 3 , 3 ) Overview of modern instrumentation techniques and digital electronic components and subsystems to integrate them into digital data acquisition and control systems for biosystems. Laboratory use of equipment is emphasized. Topics include characteristics of instruments, signal conditioning, transducer theory and applications, programmable logic controllers, and digital data acquisition and control. Preq: E C 307.
B E 421 E n g i n e e r i n g S y s t e m s f o r S o i l W a t e r M a n a g e m e n t 2 ( 1 , 3 ) Fundamentals of design related to drainage of lands, irrigation, and modification of the microenvironment for optimum productivity are presented. Preq: M TH SC 208. Co: C E 341.
B E 422, 622 H y d r o l o g i c M o d e l i n g o f S m a l l W a t e r s h e d s 3 ( 0 ) Design of structures and development of best management practices for runoff, flood, and sediment control from rural and urban areas, including natural and disturbed watersheds. Topics include modeling of prismatic and non-prismatic channels, culverts, and detention/retention ponds. Preq: B E 322 or consent of instructor.
B E ( C H E ) 428, 628 B i o c h e m i c a l E n g i n e e r i n g 3 ( 3 , 0 ) Use of microorganisms and enzymes for the production of chemical feedstocks, single-cell protein, antibiotics, and other fermentation products. Topics include kinetics and energetics of microbial metabolism, design and analysis of reactors for microbial growth and enzyme-catalyzed reactions, and considerations of scale-up, mass transfer, and sterilization during reactor design. Preq: B E 312, BIO C H 301, MICRO 305 (for Biosystems Engineering majors); Co: C H E 312, 450 (for Chemical Engineering majors).
B E 431, 631 S t r u c t u r a l D e s i g n f o r B i o s y s t e m s 2 ( 2 , 0 ) A analysis and design of structures and statically determinant components with emphasis on wood. Preq: C E 206 or M E 302.
B E 435, 635 A p p l i c a t i o n s i n B i o t e c h n o l o g y E n g i n e e r i n g 3 ( 2 , 3 ) Biotechnology principles applied to the expanding fields of agricultural biotechnology, ecotechnology, and biomedical technology. Specific applications include waste treatment and ecological engineering, bioreactor propagation of plant and animal cells and tissues, applied genomics and synthetic seed production, biosensors and bio-monitoring, biological implants and materials biocompatibility. Preq: B E ( C H E ) 428.
B E 438, 638 B i o p r o c e s s E n g i n e e r i n g D e s i g n 3 ( 2 , 2 ) Design and analysis of systems for processing biological materials. Topics include biotechnology, thermodynamics, transport processes, and biological properties related to bioprocess design and computational simulation. U nit operations include basic bioreactor operation, bioprocesses, and preservation techniques. Preq: B E 428.
B E 442, 642 P r o p e r t i e s a n d P r o c e s s i n g o f B i o l o g i c a l P r o d u c t s 2 ( 1 , 3 ) Study of engineering properties of biological materials and their uniqueness as design restraints on systems for handling, processing, and preserving biological products. Preq: B E 333, C E 341, M E 302, 310.
B E ( E E & S, F O R ) 451, H 451, 651 N ew m a n Seminar and Lecture Series in Natural Resources Engineering 1 ( 0 , 2 ) Topics dealing with development and protection of land, air, water, and related resources are covered by seminar with instructor and invited lecturers. Current environmental and/ or resource conservation issues are addressed. Preq: Senior standing, consent of instructor.
B E 464, 664 N o n - P o i n t S o u r c e M a n a g e m e n t in E n g i n e e r e d E c o s y s t e m s 3 ( 2 , 3 ) Fundamentals of non-point source pollution including quantification of environmental impact and ecosystem management related to contaminants and nutrients and to planning and design of ecological systems. Preq: MICRO 305, senior standing in engineering, or consent of instructor.
B E 473 S p e c i a l T o p i c s i n B i o s y s t e m s E n g i n e e r i n g 1 - 3 ( 1 - 3 , 0 ) Comprehensive study of special topics not covered in other courses. Emphasis is on independent pursuit of detailed investigations. Senior standing and consent of department.
B E 474 E n g i n e e r i n g P r o j e c t M a n a g e m e n t / P o r t f o l i o 2 ( 1 , 3 ) Research into applications using hydrology principles, fluid mechanics, bioprocessing, heat/mass transfer, instrumentation, mechanical unit operations, and structural principles for project design, scheduling, and cost estimation. Topics also include engineering ethics, professional development, written and oral communication, and job skills. Senior portfolios are also developed. Preq: Senior standing in Biosystems Engineering.
B E 475 B i o s y s t e m s C a p s t o n e D e s i g n 2 ( 0 , 6 ) A p p l i c a t i o n s of hydrology, fluid mechanics, bioprocessing, heat/mass transfer, instrumentation, mechanical unit operations, and structural principles in design; project scheduling; cost estimation; ethics; environmental and social impacts; design drawings; and report documentation. Preq: All 400-level engineering courses previously listed in curriculum.
B E ( E E & S, S, I E ) 484, 684 M u n i c i p a l S o l i d W a s t e M a n a g e m e n t 3 ( 3 , 0 ) See E E & S 484.

C U R R I C U L U M Courses of Instruction
Courses of Instruction

Students work and conduct research while participating in an approved study abroad. To be taken Pass/Fail only. Preq: BUS H 291.

BUS H 392 International Business Honors Thesis Proposal 1(1,0) Students work with a Clemson advisor and an international advisor to complete a proposal for the senior thesis. Students work and conduct research while participating in an approved study abroad. To be taken Pass/Fail only. Preq: BUS H 391.

BUS H 491 International Business Honors Thesis I 3(3,0) Students work with an advisor to conduct literature review and research on a senior thesis topic and prepare presentations and thesis drafts based on this work. Preq: BUS H 392.

BUS H 492 International Business Honors Thesis II 3(3,0) Students work with an advisor to complete a senior thesis. They prepare and present a seminar on the topic for presentation to faculty and other International Business Honors students. Preq: BUS H 491.