Course Descriptions - Applied Biology and Biomedical Engineering

Applied Biology and Biomedical Engineering Faculty
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Applied Biology

AB101 Essential Biology 4R-OL-4C F,W,S Pre: None
Surveys basic concepts in the biological sciences and describes how new advances related to these concepts affect contemporary society.

AB 110 Biology I □ Cell Structure and Function 3R-3L-4C F,S Pre: None
Introduces structures, mechanisms, and laboratory techniques in cellular and molecular biology. Discusses biomolecules, bioenergetics, biosynthesis, enzymatic function, genetics, and cellular regulatory systems.

AB 120 Biology II □ Comparative Anatomy & Physiology 3R-3L-4C W
Pre: None
The structural and functional relationships between tissues and organ systems are discussed using a comparative approach. The lecture is combined with laboratory exercises and observations, which may require dissection of biological specimens.

AB 130 Biology III □ Evolution and Diversity 3R-3L-4C S Pre: None
Introduces fundamental principles, important applications, and field and laboratory techniques in organismal biology. Discusses mechanisms of evolution, the history of life on earth, biological diversity, and ecology.

AB 140 Introduction to Biological Computing 1R-3L-2C S Pre: None
Introduces students to basic programming tools for biological applications. Topics may include: effective use of spreadsheet tools in data analysis and presentation, structured programming, digital data acquisition, and an introduction to computational modeling of biological systems.

AB 210 Mendelian and Molecular Genetics 3R-3L-4C F Pre: AB 110 or instructor consent
A discussion of Mendelian genetics including the molecular mechanisms of nuclear and cytoplasmic inheritance. Information flow and control of gene expression are addressed at the molecular level. Basic genetic techniques are covered in both lecture and laboratory.

AB 220 Prokaryotic Cell and Molecular Biology 3R-3L-4C W Pre: AB 110 or instructor consent
Discusses the essential properties of eubacteria and archea. Bacterial nutrition, growth, genetics and structural and metabolic diversity are discussed in detail. The basics of virology are also addressed. Fundamental laboratory methodologies are also covered.

AB 230 Eukaryotic Cell and Molecular Biology 3R-3L-4C S Pre: AB 110 or instructor consent
Examines the structure and function of various eukaryotic cells. Biomembranes, organelles, the cytoskeleton, energetics, protein sorting, signal transduction and cell interactions are discussed in detail. Essential methods in cell biology are addressed in both lectures and laboratories.
AB 301, 302 Biology Colloquium 1R-0L-1C F, W Pre: Junior standing
A discussion of selected timely topics and preparation for senior research.

AB 310 Plant Structure & Function 3R-3L-4C S Pre: AB 130 or instructor consent
Surveys the structure, physiology, diversity, evolution, and ecological importance of plants and related groups of organisms.

AB 320 Ecology 3R-3L-4C F Pre: AB 130 or instructor consent
Surveys adaptations of organisms, population dynamics, species interactions, and the structure and function of natural communities and ecosystems.

AB 330 Evolutionary Biology 3R-3L-4C W Pre: AB 130 or instructor consent
Surveys three major themes of evolutionary biology: adaptation, diversity of life, and the shared characteristics of life. Mechanisms of evolution, speciation, phylogeny, and macroevolutionary processes are discussed.

AB 401, 402, 403 Biology Colloquium 2R-0L-2C F, W, S Pre: Senior standing
Oral presentations and discussion of selected timely topics.

AB 410 Infection and Immunity 4R-0L-4C Arranged Pre: AB 110 or consent of instructor
Discussion of various pathogens, how they cause disease, and how they elicit the innate and adaptive immune responses employed to combat them. Cellular and molecular mechanisms of immunity are addressed, as is the epidemiology of various human diseases.

AB/BE 411 Genetic Engineering 4R-0L-4C Arranged Pre: AB 210 or consent of instructor
Discusses the basics of molecular biology and the genetic and molecular techniques used to engineer prokaryotic and eukaryotic cells, plants, and animals for the production of useful traits or compounds. The application of DNA technology to the diagnosis and treatment of disease is also addressed.

AB 421 Microbial Biotechnology 4R-0L-4C Arranged Pre: AB110 or consent of instructor
Discusses the fundamental biology of microprobes and the processes underlying their use in the production of chemicals, therapeutics and foods. The basics of microbial ecology and the environmental applications of microbial biotechnology are also discussed.

AB 491 Special Topics in Applied Biology XR-0L-XC Arranged Pre: Consent of instructor
Covers upper level material of mutual interest to student and instructor which cannot be acquired in any other listed AB course.

AB 492 Special Topics Applied Biology Laboratory XR-XL-XC Arranged Pre: Consent of instructor
Covers upper level biological laboratory experiments of mutual interest to the student and instructor which cannot be experienced in any other listed AB course.

AB 499 Senior Thesis Research 0R-12L-4C F, W, S Pre: Senior standing
Laboratory research under the direction of a faculty mentor. Culminates in an oral research presentation and publication of a Senior Thesis.

AB/BE 511 Human Physiology A 4R-0L-4C W (2003-2004) Pre: Junior, Senior, Graduate standing or consent of instructor
An analysis of neural, muscular, endocrine, reproductive and digestive physiology from a quantitative, systems-based approach. Both recent and classic journal articles will be discussed in class.
AB/BE 512 Human Physiology B 4R-0L-4C W (2004-2005) Pre: Junior, Senior, Graduate standing or consent of instructor
An analysis of cardiovascular, pulmonary, immune and renal physiology from a quantitative, systems-based approach. Both recent and classic journal articles will be discussed in class. (Note: BE511 is not a prerequisite for BE512).

AB/BE570 Introduction to Tissue Engineering 4R-0L-4C S Pre: Junior, Senior, Graduate standing or consent of instructor
This course provides a broad overview of the latest developments in the field of tissue engineering. Normal structure and function of tissues and organs such as bone, cartilage, nerve, skin, and liver are discussed. Methods of engineering these tissues, or encouraging healing or regeneration that would not otherwise occur, is the focus of the course. The course takes the format of a graduate seminar, with students taking an active role in presenting material to the class and leading discussions.

Biomedical Engineering

BE/AB 411 Genetic Engineering 4R-0L-4C Arranged Pre: AB 210 or consent of instructor
Discusses the basics of molecular biology and the genetic and molecular techniques used to engineer prokaryotic and eukaryotic cells, plants, and animals for the production of useful traits or compounds. The application of DNA technology to the diagnosis and treatment of disease is also addressed.

BE 422 Bioengineering Statistics 4R-0L-4C F Pre-. MA 205, MA 311 or MA 411
Estimation and hypothesis testing, regression analysis, analysis of variance, measure of risk, rates and probability, cohort analysis, survival analysis, clinical trials, quality control and susceptibility testing. Same as MA 422.

BE/AB 511 Human Physiology A 4R-0L-4C W (alternating years) Pre: Junior, Senior, Graduate standing or consent of instructor
An analysis of neural, muscular, endocrine, reproductive and digestive physiology from a quantitative, systems-based approach. Both recent and classical journal articles will be discussed in class.

BE/AB 512 Human Physiology B 4R-0L-4C W (alternating years) Pre: Junior, Senior, Graduate standing or consent of instructor
An analysis of cardiovascular, pulmonary, immune and renal physiology from a quantitative, systems-based approach. Both recent and classical journal articles will be discussed in class. (Note: BE511 is not a prerequisite for BE512).

BE516 Introduction to MEMS: Fabrication and Applications 3R-3L-4C S Pre: JR or SR standing
Properties of silicon wafers, wafer-level processes, surface and bulk micromachining, thin-film deposition, dry and wet etching, photolithography, process integration, simple actuators. Introduction to microfluidic systems. MEMS application: capacitive accelerometer, cantilever and pressure sensor. Students enrolled in BE516 must do project work on a topic selected by the instructor.

BE519 Advanced MEMS: Modeling and Packaging 3R-3L-4C F Pre: PH410 or equivalent course
Design process, modeling: analytical and numerical. Actuators; dynamics and thermal issues. Use of software for layout and simulation. Characterization and reliability of MEMS devices. Electrical interfacing and packaging of MEMS. Microsensors, microfluidic systems, applications in engineering, biology, chemistry, and physics. Students enrolled in BE519 must do project work on a topic selected by the instructor.

BE 525 Biomedical Fluid Mechanics 4R-0L-4C Pre: EM 301 or CHE 301 or ES202 or consent of instructor
Includes cardiovascular physiology, Poiseuille flow, pulsatile flow in rigid tubes, pulsatile flow in large arteries, blood flow in the microcirculation, flow and pressure measurement, prosthetic heart valves, prosthetic arteries, dimensional analysis and modeling.

**BE 530 Biomechanics 4R-0L-4C Pre: ES201 or EM120 or consent of instructor**
Covers statics, dynamics and deformable body mechanics of biological systems. Topics include biomechanics of distance running, physiological response to acceleration, mechanics of bone, joint biomechanics and selected topics from current literature.

**BE535/OE535 Biomedical Optics 4R-0L-4C Pre: PH 113, MA 202 or MA 213, and JR/SR/GR standing or consent of instructor**
Optical techniques for biomedical applications and health care; laser fundamentals, theory and applications of laser light interaction with tissue; therapeutic and diagnostic applications of lasers in medicine; optics based clinical devices and applications.

**BE540/PH540 Biomechanics 4R-0L-4C Pre: PH 113, MA 202 or MA 213, and JR/SR/GR standing or consent of instructor**
Heat transfer in biological tissue; determination of thermodynamic and transport properties of tissue; clinical applications of heat transfer for diagnosis and therapy. Calculation of the rate of heat production caused by direct absorption of laser light, calculation of thermal damage, and calculation of ablation.

**BE 550 Biomedical Instrumentation 4R-0L-4C F Pre, Senior, Graduate standing or consent of instructor**
Topics include circuit analysis, frequency analysis, biomedical transducers, design of biomedical devices, introduction to imaging techniques.

**BE555 Electrophysiology 4R-0L-4C Pre: Junior, Senior, Graduate standing or consent of instructor**
Introduces students to concepts of electrical activity in cells and organs of the body. Topics include: origin of membrane potential, membrane channels, synaptic signaling, recording techniques, gross electrical potentials (e.g. electrocardiogram, electroencephalogram, electromyogram, electroretinogram). Emphasis will be placed on how these signals are used to probe physiological function in the clinic and in the research laboratory.

**BE 560 Biomaterials □ Artificial Organs 4R-0L-4C Pre: Junior, Senior class standing or consent of instructor**
Consecutively treats discussion of biocompatibility, anatomy and physiology of major organs, review of the status of artificial heart valves, kidney, liver, pancreas, ear, eye, pacemaker, defibrillator and heart assist devices, cell physiology, with special emphasis on the immune system, research techniques used in the evaluation of biomaterials and artificial organs, chemical and physical properties of polymers and metals used as biomaterials.

**BE 561 Biomaterials □ Prosthetic Devices 4R-0L-4C Pre: Junior, Senior class standing or consent of instructor**
Consecutively treats chemical and physical property of ceramics, carbons, and composites used as bio-materials, anatomy of the musculoskeletal system, bone and muscle physiology, review of the status of artificial hips, knees, shoulders, fingers, fixation devices and spinal implants. Extensive discussion on the problems of wear, corrosion, fretting and fatigue of prosthetic devices, review of the status of maxillofacial implants.

**BE 562 Biomaterials □ Medical Devices, Surgical and Medical Instrumentation 4R-0L-4C S Pre: Junior, Senior, Graduate standing or permission of instructor**
Review of the status of dental, maxillofacial and percutaneous implants, materials for surgical instruments, laparoscopy surgery and endoscopy surgery.

**BE/AB 570 Introduction to Tissue Engineering 4R-0L-4C S Pre: Junior, Senior, or Graduate standing or permission of instructor**
This course provides a broad overview of the latest developments in the field of tissue engineering. Normal structure and function of tissues and organs such as bone, cartilage, nerve, skin, and liver are discussed. Methods of engineering these tissues, or encouraging healing or regeneration that would not otherwise occur, is the focus of the course. The course takes the format of a graduate seminar, with students taking an active role in presenting material to the class and leading discussions.

**BE 590 Thesis Research FWS**
Credits as assigned; however, not more than 12 credits will be applied toward the requirements of an M.S. degree.

**BE 597 Selected Topics for Graduate Students Credits as assigned. Maximum 4 credits per term. F,W,S**
The following courses are offered at the Terre Haute Center for Medical Education and may be taken for Rose-Hulman credit. To enroll in these courses RHIT students need permission from the Chairman of the Department of Applied Biology and Biomedical Engineering. BE 623 and BE 624 are typically offered in fall semester and BE 621 and BE 625 are typically offered in spring semester.

**BE 621 Microbiology and Immunology (6 cr.)**
Lectures, conferences and laboratories covering the immune response as a chemical and cellular Surveillance system; the consequences of activation of the immune system; and viruses, bacteria, fungi and protozoan and metazoan parasites as organisms and as agents of human disease.

**BE 623 Gross Anatomy (8 cr.)**
An intensive study of the gross structure of the human body accomplished through maximum student participation in the dissection of the human cadaver. Lectures are interpretive and correlative. Audiovisual supplementation is provided.

**BE 624 Biochemistry (6 cr.)**
The chemistry and reactions of constituents of living matter, including the carbohydrates, lipids, proteins, nucleic acids, vitamins, coenzymes and minerals; the chemistry and regulation of the reactions and processes of whole organisms; endocrinology; enzymology; nutrition; intermediary metabolism; and biochemical mechanisms in selected disease states.

**BE 625 Physiology (8 cr.)**
The course in human physiology covers, in lectures and laboratories, such topics as circulation, respiration, digestion, endocrinology, heat metabolism, renal physiology, muscle physiology, and neurophysiology.