

Suggested Courses for ME Students Interested in Biomechanics/Biomedical Engineering:

Virginia Tech is has a biomedical engineering minor for undergraduate students. ME students can use courses to count for both their ME degree and the Biomedical Engineering minor. For more information about the minor, please see: http://www.sbes.vt.edu/pdf/undergrad_ad.pdf. You may contact Ms. Amanda Sandridge agstanle@vt.edu if you have questions about the minor.

ME 4015-4016 – Engineering Design and Project (6 credits total)

Select from various biomechanics/biomedical projects which can count as the biomedical research requirement for the minor.

Technical Electives:

A limit of 6 credits of List #2 technical electives can be used to satisfy the 15 credits of technical electives required to earn a BSME degree. There is no limit in List #1 technical electives. Be sure to consult the current list of approved technical electives for the year in which you plan to graduate to make sure the courses listed below are valid technical electives.

List #2 Technical Elective:

BMES 2104 – Introduction to Biomedical Engineering

****required course for biomedical minor****

Methods of mathematical modeling and engineering analyses related to human physiology. Emphasis placed on fundamental concepts such as biomaterials, biomechanics, tissue engineering, biomedical imaging and nanomedicine. Broad spectrum of current biomedical engineering research areas. Pre: (ENGE 1104 or ENGE 1114), PHYS 2305. Co: MATH 2214.

List #1 Technical Electives:

BMES 4064 (BMVS 4064): Intro to Medical Physiology. Fall only.

****required course for biomedical minor****

An introductory to the principles of medical physiology. Designed primarily for (but not limited to), undergraduate students minoring in biomedical engineering, and other related engineering and physical sciences majors with little or no formal background in biological sciences. Basic principles and concepts of human physiology. Special emphasis on the interactions of human systems biology in their entirety rather than individual genes and pathways. Pre: Junior standing or permission of instructor.

ME 4034: Bio-Inspired Technology

Introduction to engineering solutions inspired by biological systems. Overview over the approach of bio-inspired technology and the state of the art. Exploration of the relationship between engineered and natural biological systems. Explanation of concepts of biological systems, such as evolutionary optimization, sensing, actuation, control, system integration, assembly and materials in engineering terms. Practice of interdisciplinary analysis skills in technical report writing projects where man-made and biological systems are evaluated for parallels to engineering and their technological potential. Pre: (PHYS 2205, PHYS 2206) or (PHYS 2305, PHYS 2306). (3H,3C)

ME 4864: Micro/Nano-Robotics

Overview of Micro/Nano-robotic systems. Physics of reduced length scales (scaling effects in the physical parameters, surface forces, contact mechanics, and micro/nano-scale dynamical phenomena), Basics of micro/nano-manufacturing, microfabrication and soft lithography, Biomimetic design strategies for mobile micro-robots, Principle of transduction, material properties and characteristics of Micro/nano-actuators (piezoelectric, shape-memory alloy, and a variety of MEMS and polymer actuators), Control requirements and challenges of micro/nano-actuators, Micro/nano sensors for mobile microrobotic applications, Micro/nano-manipulation (scanning probe microscopy, operation principles, designing experiments for nanoscale mechanical characterization of desired samples). Pre: MATH 2214, ME 3404, ME 3514.

ESM 4105-4106 - Engineering Analysis of Physiological Systems - I & II (3 credits each)

Engineering analysis of human physiology. Physiologic systems are treated as engineering systems with emphasis input-output considerations, system interrelationships and engineering analogs. 4105 - Mass and electrolyte transfer, nerves, muscles, renal system. 4106 - cardiovascular mechanics, respiratory system, digestive systems, senses. (2H,3L,3C) 4016: (1H,6L,3C). Pre: ESM 2304, MATH 2214

ESM 4204 - Musculoskeletal Biomechanics and Biologic Control (3 credits)

Skeletal anatomy and mechanics. Muscle anatomy and mechanics. Theory and application of electromyography. Motion and force measuring equipment and techniques. Inverse dynamics modeling of the human body. Current topics in musculoskeletal biomechanics research. Pre: ESM2304 or ESM2074 or AOE 2074 or CS 1044 or CS 1064 or CS 1114 or ME 2004).

ESM 4224 - Biodynamics and Control (3 credits). Spring only.

Study of human movement dynamics and neuromuscular control of multi-degree-of-freedom systems. Computational simulation of forward-dynamics and state-space linear control of human movement to investigate functional performance and neuromuscular pathology. Pre: ESM3124, ESM4204.

ESM 4245,4246: Mechanics of Animal Locomotion (3 credits)

Mechanical and biological principles of terrestrial animal locomotion, including walking, running, climbing, burrowing, and crawling. Terrestrial locomotion-based bio-inspired design. Pre: ESM 3054 for 4245; ESM 3015 for 4246.

ESM 4324 - Mechanics of Biological Materials and Structures (3 credits)

Anatomy and physiology of connective tissue. Techniques for determining the mechanical response of biological soft and hard tissues. Includes static, viscoelastic, creep, fatigue, and fracture. Simplified models of biological structures. Creation of geometric models from medical imaging and computational modeling. Specific topics may include bone, cartilage, ligaments, tendon, teeth, and skin. Pre: ESM3054, (ESM2074 or ME 2004).

ESM 4304 - Hemodynamics (3 credits) Spring only.

Study of the human cardiovascular system and blood flow. Anatomy and physiology of the human heart, vascular system, and its organization. Blood physiology and rheology. Non-Newtonian blood flow models. Steady and pulsatile blood flow in rigid and elastic arteries. Pressure waves in elastic arteries. Three-dimensional blood flow in the aortic arch and flow around heart valves. Pre: ME 3404.

ISE 3614 - Human Factors and Ergonomics Engineering (3 credits) Spring Only.

Investigation of human factors, ergonomics, and work measurements engineering, with emphasis on a systems approach toward workplace and machine design. Discussion of basic human factors research and design methods, design/evaluation methods for work systems and human machine interactions, human information processing, visual and auditory processes, display and control design, and effects of environmental stressors on humans. Pre: (ISE 2204 or 2214), STAT 4105.

MSE 4574 – Biomaterials (3 credits) Spring only.

Lectures and problems dealing with materials used to mimic/replace body functions. Topics include basic material types and possible functions, tissue response mechanisms, and considerations for long term usage. Integrated design issues of multicomponent materials design in prosthetic devices for hard and soft tissues are discussed. Must meet prerequisite or have graduate standing in the College of Veterinary Medicine. Pre: MSE 3054 or ESM 3054.

MSE 4584 – Biomimetic Materials (3 credits) Fall only.

Introduction to structure property relationships in biological materials such as wood, bone, shells, spider silk, connective tissue, blood vessels and jellyfish. Proteins and polysaccharides, biosynthesis and assembly, biomineralization, hierarchical organization. Introduction to tissue engineering and regenerative medicine. Life cycle, environmental aspects of biofabrication. Pre: CHEM 1036 or BIOL 1106 or MSE 2034 or MSE 3094 or AOE 3094.

** courses in grey have not been taught in at least one academic year and may not be available*