

2011-13 Cal Poly Catalog

Biomedical and General Engineering Department

BMED–BIOMEDICAL ENGINEERING

BMED 111 Biomedical Engineering Calculations (3)

General introduction to bioengineering application of basic engineering science applied to topics in biomechanics, bioinstrumentation, biomaterials, biotechnology, and related areas. Application of the concepts and methods of science, mathematics and engineering to problems in biomedical engineering. 3 lectures. Corequisite: MATH 142 or consent of instructor.

BMED 212 Introduction to Biomedical Engineering Design (3)

General introduction to bioengineering design, including examples of engineering analysis and design applied to representative topics in biomechanics, bioinstrumentation, biomaterials, biotechnology, and related areas. Review of technological needs, design methodology, testing procedures, statistical analysis, governmental regulation, evaluation of costs and benefits, quality of life, and ethical issues. 2 lectures, 1 laboratory. Prerequisite: MATH 143 or consent of instructor.

BMED 270 Selected Topics (1–4)

Directed group study of selected topics. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1 to 4 lectures. Prerequisite: Open to undergraduate students and consent of instructor.

BMED 310 Biomedical Engineering Management and Analysis (4)

Fundamentals of biomedical engineering analysis. Use and application of tools and analytical methods used by bioengineers. 3 lectures, 1 laboratory. Prerequisite: EE 201 and CSC 101 or CSC 234 or consent of instructor.

BMED 355 Electrical Engineering Concepts for Biomedical Engineering (4)

An introduction to electrical engineering concepts for biomedical engineers. Continuation of basic circuit analysis. Steady state AC circuit analysis and phasor concepts. Application of the Laplace Transform to transient circuit analysis. An introduction to digital logic gates, combinational and sequential logic circuits. 4 lectures. Prerequisite: EE 201, MATH 344.

BMED 400 Special Problems for Advanced Undergraduates (2-4)

Individual investigation, research, studies or surveys of selected problems. Total credit limited to 8 units. Prerequisite: ME 212, junior standing and consent of department chair.

BMED 404 Applied Finite Element Analysis (4)

Finite element based solutions to engineering problems with an emphasis on elastostatic problems in structural mechanics. The power and pitfalls associated with the finite element method highlighted through practical modeling assignments. Introduces the use of commercial finite element codes. 3 lectures, 1 laboratory. Prerequisite: ME 329 or CE 351 or BMED 410. *Crosslisted as BMED/CE/ME 404.*

BMED 410 Biomechanics (4)

Introduction to physiological systems, with emphasis on structure and function of major tissues and organs. Application of mechanics to understand the behavior of these tissues and organs at gross and microscopic levels. Bioelastic solids. Rigid body biomechanics. Biofluids, basic mechanical properties of collagen and elastin, bone, cartilage, muscles, blood vessels, and other living tissues. Application of continuum mechanics to hard and soft tissues. Biomechanical engineering design for clinical applications. 3 lectures, 1 laboratory. Prerequisite: ME 212, CE 204, BMED 310 or consent of instructor.

BMED 420 Principles of Biomaterials Design (4)

Fundamentals of materials science as applied to bioengineering design. Natural and synthetic polymeric materials. Materials characterization and design. Wound repair, blood clotting, foreign body response, transplantation biology, biocompatibility of materials, tissue engineering. Artificial organs and medical devices. Government regulations. Patenting. Ethical issues. 3 lectures, 1 laboratory. Prerequisite: CE 204, MATE 210 or consent of instructor.

BMED 425 Biomedical Engineering Transport (4)

Mass transfer in solids, liquids, and gases with application to biological systems. Free and facilitated diffusion. Convective mass transfer. Diffusion-reaction phenomena. Active transport. Biological mass transfer coefficients. Nonequilibrium thermodynamic analysis of transport phenomena. The osmotic

effect. Diffusion and exchange in biological systems. 3 lectures, 1 laboratory. Prerequisite: ME 302, ME 341 or consent of instructor.

BMED 430 Biomedical Modeling and Simulation (2)

Finite element methods for anatomical modeling and boundary value problems in the biomechanics of tissues and biomedical devices. Nonlinear biodynamics, heat flow, cardiac impulse propagation, anatomic modeling, and biomechanics. 1 lecture, 1 laboratory. Prerequisite: BMED 425 or consent of instructor.

BMED 440 Bioelectronics and Instrumentation (4)

Analog and digital circuits in bioinstrumentation. Biomedical signals in continuous and discrete systems. Sampling and digital signal processing. Ultrasound, MRI, CT, Bioelectromagnetics. Electrokinetics. Biophysical phenomena, transducers, and electronics as related to the design of biomedical instrumentation. Potentiometric and amperometric signals and amplifiers. Biopotentials, membrane potentials, chemical sensors. Mechanical transducers for displacement, force and pressure. Temperature sensors. Flow sensors. Light-based instrumentation. Electrical safety. 3 lectures, 1 laboratory. Prerequisite: EE 201, BMED 310 or consent of instructor.

BMED 445 Biopotential Instrumentation (4)

Focus on the principles associated with instrumentation used to detect surface biopotentials. Emphasis on circuit level design and laboratory implementation of systems used to detect ECG, EMG and EEG signals. Development of practical experience with analog electronic instrumentation used in the design and testing process. A system level design project related to surface biopotential detection and recording. 2 lectures, 2 laboratories. Prerequisite: BMED 440.

BMED 450 Contemporary Issues in Biomedical Engineering (4)

Current and evolving topics in biomedical engineering, including medical and industrial applications. Exploration of contemporary issues in biomedical engineering, including technical and societal implications. The Schedule of Classes will list topic selected. Total credit limited to 16 units. 4 lectures. Prerequisite: Senior standing in Biomedical Engineering.

BMED 455, 456 Biomedical Engineering Design I, II (4) (4)

Engineering design methodology, design process, project planning, decision making, modeling, construction, and testing of an open-ended design project. Preparation of formal engineering reports. Statistical analysis. Governmental regulations. Bioethical issues. 2 lectures, 2 laboratories. **BMED 455** prerequisite: BMED 410 or consent of instructor. **BMED 456** prerequisite: BMED 455 or consent of instructor.

BMED 460 Engineering Physiology (4)

Physiology for biomedical engineering students, with an emphasis on control mechanisms and engineering principles. Engineering aspects of basic cell functions; biological control systems; muscle; neural; endocrine, and circulatory systems, digestive, respiratory, renal, and reproductive systems; regulation of metabolism, and defense mechanisms. 3 lectures, 1 laboratory. Prerequisite: ZOO 331 or ZOO 332, and or equivalent, BMED 310 or graduate standing, or consent of instructor. *Change effective Winter 2012.*

BMED 470 Selected Advanced Topics (1–4)

Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1 to 4 lectures. Prerequisite: Consent of instructor.

BMED 471 Selected Advanced Laboratory (1–4)

Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1 to 4 laboratories. Prerequisite: Consent of instructor.

BMED 481 Senior Project Design Laboratory I (1)

Selection and development of project by individuals or team which is typical of problems graduates must solve in their fields of employment or applied research. Project may involve, but is not limited to, physical modeling and testing of integrated design projects, costs, planning, scheduling and research. Formulation of outline, literature review, and project schedule. 1 laboratory. Prerequisite: MATH 244, IME 314, ME 302 or consent of instructor.

BMED 482 Senior Project Design Laboratory II (1)

Continuation of BMED 481. Continuation of project by individuals or team which is typical of problems graduates must solve in their fields of employment or applied research. Project may involve, but is not limited to, physical modeling and testing of integrated design projects, costs, planning, scheduling and research. Formulation of outline, literature review, and project schedule. 1 laboratory. Prerequisite: BMED 481 or consent of instructor.

BMED 483 Senior Project Design Laboratory III (2)

Continuation of BMED 482. Continuation of project by individuals or team which is typical of problems graduates must solve in their fields of employment or applied research. Project may involve, but is not limited to, physical modeling and testing of integrated design projects, costs, planning, scheduling and research. Formulation of outline, literature review, and project schedule. 2 laboratories. Prerequisite: BMED 482 or consent of instructor.

BMED 500 Individual Study (2-4)

Individual investigation, research, studies or surveys of selected problems. Advanced study planned and completed under the direction of faculty. Open to graduate students who have demonstrated the ability to do independent work. Total credit limited to 8 units. Prerequisite: Graduate standing and consent of department chair.

BMED 510 Principles of Tissue Engineering (4)

Exploration of areas including cell source and isolation, scaffold selection and modification, tissue cultivation and bioreactor design, and patient implantation. Applications of tissue engineering for creating skin, cartilage, blood vessels, and other tissues. 3 lectures, 1 laboratory. Prerequisite: An upper division course in physiology.

BMED 512 Biomedical Engineering Horizons (4)

Examination of the advances in nanotechnology, micro-electro-mechanical systems, materials and clinical technology. Relationship between modern medical achievements and advances in engineering and science, the biomedical engineering industry, and the use of technology in a human context. 4 lectures. Prerequisite: Graduate standing, MATH 143, CHEM 125, PHYS 131 or PHYS 141, BIO 161 or consent of instructor.

BMED 515 Introduction to Biomedical Imaging (4)

Introduction to the fundamental principles and applications of biomedical imaging modalities in medicine. Topics include X-ray radiography, computed tomography, magnetic resonance imaging, ultrasound, nuclear medicine, and optical imaging. 2 lectures, 2 laboratories. Prerequisite: PHYS 132, MATH 244, graduate standing; or consent of instructor.

BMED 520 Introduction to Biomedical Engineering (4)

Advanced treatment of the basic engineering sciences in the biomedical engineering context. For the student who has had little prior exposure to biomedical engineering, but has either a strong engineering or a strong science background. 4 lectures. Prerequisite: Graduate standing.

BMED 525 Skeletal Tissue Mechanics (4)

Overview of the mechanical properties of various tissues in the musculoskeletal system, the relationship of these properties to anatomic and histologic structures, and the changes in these properties caused by aging, disease, overuse, and disuse. Tissues covered include bone, cartilage and synovial fluid, ligament, and tendon. 4 lectures. Prerequisite: CE 204, BMED 460.

BMED 530 Biomaterials (4)

Structure-function relationships for materials in contact with biological systems. Interactions of materials implanted in the body. Histological and hematological considerations including foreign body responses, inflammation, carcinogenicity, thrombosis, hemolysis, immunogenic and toxic properties. Microbial interaction with material surfaces, degradation. 4 lectures. Prerequisite: **BIO 161, or BIO 213 and ENGR 213; MATE 210 and graduate standing or consent of instructor. Crosslisted as BMED/MATE 530. Change effective Fall 2011.**

BMED 535 Bioseparations (4)

Advanced topics in physicochemical hydrodynamics, bioseparations and microfluidic bioseparations, which include the key aspects of electrokinetics, colloid science and suspension mechanics in bioseparations. Understanding key separation design parameters through theoretical and numerical models. 4 lectures. Prerequisite: BMED 425, ME 341 or consent of instructor.

BMED 540 Microcirculation (4)

Anatomy and physiology of microcirculation, including wall structure, flow regulation, nutrient exchange, inflammation, and angiogenesis. Additional focus on experimental approaches, the primary literature, microcirculatory pathophysiology, and the role of engineering approaches to assess and treat microvascular dysfunction. 3 lectures, 1 laboratory. Prerequisite: BMED 460 or BIO 433 or equivalent.

BMED 545 Cell Transplantation and Biotherapeutics (4)

Lecture topics include patho-physiology, disease models, rodent anatomy, and therapeutic strategies. Laboratory topics include rodent handling, survival surgery, therapy delivery, and measurements of organ function or repair. Focus on experimental design, data collection and analysis, and literature integration. 2

lectures, 2 laboratories. Prerequisite: Statistics - STAT 312 or STAT 218; Physiology - BMED 460, BIO 361, or ASCI 438.

BMED 550 Current and Evolving Topics in Biomedical Engineering (4)

Current topics in biomedical engineering, including medical and industrial applications. Exploration of detailed technical treatment of contemporary issues in biomedical engineering, and examination of technical and societal implications of these subjects. The Schedule of Classes will list topic selected. Total credit limited to 8 units. 4 lectures. Prerequisite: Graduate standing in biomedical engineering or consent of department chair.

BMED 555 Neural Systems Simulation and Modeling (4)

The biophysical basis of the Hodgkin-Huxley active membrane model. A detailed description of the dynamics of voltage gated ion channels. The complete Hodgkin-Huxley active membrane model, with an emphasis on its use in simulating the electrical activity of nerve cells. Equivalent circuit/ circuit simulator based approaches to modeling Hodgkin-Huxley neurons. 4 lectures. Prerequisite: MATH 244, BMED 440.

BMED 563 Biomedical Engineering Graduate Seminar (2)

Selected topics of interest to biomedical engineering and other graduate students. Open to graduate students and selected seniors. A forum to share information about research and research tools; an opportunity to discuss topics of interest with professionals in the field, academics, and other graduate students. The Schedule of Classes will list topic selected. Total credit limited to 4 units. 1 seminar, 1 laboratory. Prerequisite: Graduate standing or consent of instructor.

BMED 570 Selected Advanced Topics (1-4)

Directed group study of selected topics for graduate students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1-4 lectures. Prerequisite: Graduate standing or consent of instructor.

BMED 571 Selected Advanced Laboratory (1-4)

Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1-4 laboratories. Prerequisite: Graduate standing or consent of instructor.

BMED 591 Thesis Project Design Laboratory I (2)

Selection and development of project by individuals or team which is typical of problems graduates must solve in their fields of employment or applied research. Project may involve, but is not limited to, physical modeling and testing of integrated design projects, costs, planning, scheduling and research. Formulation of outline, literature review, and project schedule. 2 laboratories. Prerequisite: Graduate standing.

BMED 592 Thesis Project Design Laboratory II (2)

Continuation of BMED 591. Completion of project by individuals or team which is typical of problems graduates must solve in their fields of employment or applied research. Project may involve, but is not limited to, physical modeling and testing of integrated design projects, costs, planning, scheduling and research. Formulation of outline, literature review, and project schedule. 2 laboratories. Prerequisite: BMED 591 or consent of instructor.

BMED 593 Stem Cell Research Internship (5)

Supervised graduate research in stem cell science and engineering. Provides students with an off-campus industrial or university research internship. Total credit limited to 10 units. Prerequisite: Graduate standing in the Specialization in Stem Cell Research for the MS in Biological Sciences or for the MS in Biomedical Engineering, or the Animal Science Specialization in the MS in Agriculture, and BMED 510, BMED 545, BMED 515, and BIO 534. *Crosslisted as ASCI/BIO/BMED 593.*

BMED 594 Applications in Stem Cell Research (2)

Transfer of skills and knowledge gained through ASCI/BIO/BMED 593, in an applied setting at Cal Poly. Demonstration of technical, problem solving, and presentation skills, and familiarity with current research. Part of the culminating experience for the Specialization in Stem Cell Research for the MS in Biological Sciences or for the MS in Biomedical Engineering, or the Animal Science Specialization in the MS in Agriculture. 1 seminar and supervised work. Prerequisite: ASCI/BIO/BMED 593 *Crosslisted as ASCI/BIO/BMED 594.*

BMED 599 Design Project (Thesis) (1-9)

Selection by individual or group, with faculty guidance and approval, of topic for independent research or investigation resulting in a thesis or project to be used to satisfy the degree requirement. An appropriate experimental or analytical thesis or project may be accepted. Total credit limited to 9 units. Prerequisite: Graduate standing.