BIOMEDICAL ENGINEERING
(BMD_ENG)

BMD_ENG 101-0 Introduction to Biomedical Engineering (0 Unit)
Information to 1) help students determine if BME is the right major for them and 2) learn how to make the most of their undergraduate experience. The field of biomedical engineering, career and research opportunities, ethics.

BMD_ENG 207-0 BME Lab: Experimental Design (0.5 Unit)
A laboratory course focusing on quantitative physiological measurements and analyses, instrument characterization, statistical design of experiments, and training in preparation and organization of laboratory notes and reports. Prerequisite: AP stats or BMD_ENG 220-0 or IEMS 303-0 or MECH_ENG 359-0.

BMD_ENG 220-0 Introduction to Biomedical Statistics (1 Unit)
Basic statistical concepts presented with emphasis on their relevance to biological and medical investigations.

BMD_ENG 250-0 Thermodynamics (1 Unit)
Physical and chemical principles as applied to biological systems and medical devices. Topics include material balances, thermodynamics, solution chemistry, electrochemistry, surface chemistry, transport, and kinetics. Prerequisites: MATH 228-1; CHEM 132-0, CHEM 152-0, or CHEM 172-0.

BMD_ENG 270-0 Fluid Mechanics (1 Unit)
Fundamentals of fluid mechanics and their applications to biological systems. Prerequisites: GEN_ENG 205-4; MATH 228-2.

BMD_ENG 271-0 Introduction to Biomechanics (1 Unit)
Analysis of stresses and deformations in solids. Problems in biomechanics, with emphasis on assumptions appropriate to modeling biological materials including bone, skin, muscle, and cell membranes. Prerequisite: GEN_ENG 205-2.

BMD_ENG 301-0 Quantitative Systems Physiology (1 Unit)
Functional/structural aspects of mammalian nervous system. Neural biophysics. Laboratory exercises. Prerequisite: PHYSICS 135-2; junior standing recommended.

BMD_ENG 302-0 Quantitative Systems Physiology (1 Unit)
Rigorous overview of cardiovascular and respiratory anatomy, physiology, and pathophysiology. Case studies and a design team project. Prerequisite: MATH 228-1; junior standing recommended.

BMD_ENG 303-0 Quantitative Systems Physiology (1 Unit)
Cellular mechanisms of and quantitative systems' approach to human renal, digestive, endocrine, and metabolic physiology. Prerequisite: junior standing recommended.

BMD_ENG 305-0 Introduction to Biomedical Signals and Electrical Circuits (1 Unit)
Time and frequency domain analysis: convolution representation, Fourier series, Fourier transforms, frequency response, filtering, sampling. Prerequisite: PHYSICS 135-2 or consent of instructor.

BMD_ENG 306-0 Biomedical Systems Analysis (1 Unit)
Introduction to linear systems analysis. Time and frequency domain techniques for analyzing linear systems, emphasizing their applications to biomedical systems. MATLAB-based problem sets and lab illustrate topics covered in class. Prerequisites: BMD_ENG 305-0, BMD_ENG 220-0, IEMS 303-0, or MECH_ENG 359-0, GEN_ENG 205-4.

BMD_ENG 307-0 Quantitative Experimentation and Design (1 Unit)
Laboratory and associated lecture concerning quantitative physiology, physiological measurement techniques, instrument design, and statistical design of experiments. Prerequisites: BMD_ENG 305-0, BMD_ENG 306-0, BMD_ENG 220-0, IEMS 303-0 or MECH_ENG 359-0.

BMD_ENG 308-0 Biomedical Signals and Circuits (1.25 Unit)
Time and frequency domain analysis: convolution representation, Fourier series, Fourier transforms, frequency response, filtering, sampling. Prerequisite: PHYSICS 135-2 or consent of instructor.

BMD_ENG 309-0 Biomedical Systems Analysis (1.25 Unit)
Introduction to linear systems analysis. Time and frequency domain techniques for analyzing linear systems, emphasizing their applications to biomedical systems. MATLAB-based problem sets and lab illustrate topics covered in class. Prerequisites: BMD_ENG 207-0 (can also be taken concurrently); BMD_ENG 308-0, BMD_ENG 220-0, IEMS 303-0, or MECH_ENG 359-0, GEN_ENG 205-4.

BMD_ENG 314-0 Models in Biochemistry & Molecular Biology (1 Unit)
Mathematical modeling of biochemical and molecular biological problems, such as allosteric enzymes, bacterial transduction, X-ray diffraction, study of DNA. Prerequisites: BIOL_SCI 215-0; BIOL_SCI 219-0; junior standing recommended.

BMD_ENG 315-0 Application of Genetic Engineering to Immunochemistry (1 Unit)
Recent developments in genetic engineering as applied to the rapidly developing field of immunochemistry for antibodies and related proteins. Prerequisite: junior standing recommended.

BMD_ENG 316-0 Engineering Design of Therapeutic Antibodies (1 Unit)
In-depth study of the development of therapeutic antibodies through protein engineering-the process of selectively modifying the activities of existing proteins and enzymes to improve their function. Prerequisites: BIOL_SCI 215-0; BIOL_SCI 219-0.

BMD_ENG 317-0 Biochemical Sensors (1 Unit)
Theory, design, and applications of chemical sensors used in medical diagnosis and patient monitoring. Electrochemical and optical sensors. Prerequisites: BIOL_SCI 215-0; BIOL_SCI 219-0; CHEM 210-1; PHYSICS 135-2; PHYSICS 135-3.

BMD_ENG 323-0 Visual Engineering Science (1 Unit)

BMD_ENG 325-0 Introduction to Medical Imaging (1 Unit)
Diagnostic X-rays; X-ray film and radiographic image; computed tomography; ultrasound. Prerequisite: PHYSICS 135-3 or equivalent.

BMD_ENG 327-0 Magnetic Resonance Imaging (1 Unit)
Nuclear magnetic resonance; two-dimensional Fourier transform, spin echo and gradient echo imaging; gradient and RF hardware. Prerequisite: PHYSICS 135-3.

BMD_ENG 333-0 Modern Optical Microscopy & Imaging (1 Unit)
Rigorous introduction to principles, current trends, emerging technologies, and biomedical applications of modern optical microscopy. Prerequisites: PHYSICS 135-2; MATH 220-1; MATH 228-1; GEN_ENG 205-4.

BMD_ENG 343-0 Biomaterials and Medical Devices (1 Unit)
Structure-property relationships for biomaterials. Metal, ceramic, and polymeric implant materials and their implant applications. Interactions of materials with the body. Taught with MAT_SCI 370-0; may not receive credit for both courses.
viscoelastic, pseudo-elastic, and biphasic models. Stress and strain for small and large deformations. Nonlinear elastic, orthopedics. Models of muscle and tendon, kinematics of joints, and dynamics of passive and active components for sensitive, multimodal, and robust devices for biointegrated electronics. Materials design and fabrication methodologies used in support of health technology planning, assessment and adoption - and related decision making - as part of cost-effective healthcare delivery. Open to participants in the Global Health Technologies Program only.

BMD_ENG 347-0 Foundations of Regenerative Engineering (1 Unit)
Embryonic development, stem cell engineering, somatic regeneration, genome and transcriptome modifications, cell and tissue-level regenerative engineering. Prerequisite: BMD_ENG 215-0 or BMD_ENG 219-0.

BMD_ENG 348-0 Applications of Regenerative Engineering (1 Unit)
Mechanisms of human disease, development and application of molecular, cellular, and tissue-level regenerative engineering strategies to selected human disorders, including neurodegenerative disorders, stroke, cystic fibrosis, cirrhosis, diabetes, muscular degenerative disorders, and skin injury. Prerequisite: BMD_ENG 215-0 or BMD_ENG 219-0.

BMD_ENG 349-1 Regenerative Engineering Principles and Technologies (1 Unit)
Foundations, principles, and technologies of molecular, cellular, and tissue regenerative engineering. Prerequisites: BMD_ENG 215-0 or BMD_ENG 219-0.

BMD_ENG 349-2 Regenerative Engineering Applications (1 Unit)
Fundamentals of human disorders; engineering aspects of regenerative medicine; application of regenerative engineering to human disease. Prerequisite: BMD_ENG 349-1.

BMD_ENG 353-0 Bioelectronics (1 Unit)
Development and design of sensors, stimulators, and their medical devices for biointegrated electronics. Materials design and fabrication of passive and active components for sensitive, multimodal, and robust wearable and implantable devices. Prerequisite: BMD_ENG 307-0.

BMD_ENG 354-0 Bioelectronics Lab (0.34 Unit)
Laboratories focused on the practical implementation, instrumentation, and fabrication of wearables and skinsensing. Applications range from vital sign monitoring to rehability. Prerequisite: senior standing with engineering or physical science background.

BMD_ENG 366-0 Biomechanics of Movement (1 Unit)
Engineering mechanics applied to analyze human movement, including models of muscle and tendon, kinematics of joints, and dynamics of multi-joint movement. Applications in sports, rehabilitation, and orthopedics. Prerequisite: BMD_ENG 271-0.

BMD_ENG 371-0 Mechanics of Biological Tissue (1 Unit)
Stress and strain for small and large deformations. Nonlinear elastic, viscoelastic, pseudo-elastic, and biphasic models. See Dept for section and permission numbers.

BMD_ENG 377-0 Intermediate Fluid Mechanics (1 Unit)
Fundamental concepts of fluid dynamics. Kinematics, mass and momentum balances, constitutive relations. Navier-Stokes equations and methods of solution. Sealing techniques. Prerequisite: BMD_ENG 270-0 or consent of instructor.

BMD_ENG 378-0 Transport Fundamentals (1 Unit)
Fundamental and biomedical applications of diffusive and convective heat and mass transfer. Prerequisites: BMD_ENG 270-0, MATH 228-1, BMD_ENG 377-0 recommended.

BMD_ENG 380-0 Medical Devices, Disease & Global Health (1 Unit)
Health systems and technologies to address health problems of the world’s underserved populations, with special emphasis on developing countries.

BMD_ENG 388-SA Health Systems Engineering (1 Unit)
Introduction to health systems in the context of disease burden with special emphasis in developing countries. We examine healthcare systems, financing, data and analytics. The course focuses primarily on health-related issues confronting South Africa and the associated social and economic impact. Prerequisite: consent of instructor.

BMD_ENG 389-SA Health Technology Management (1 Unit)
This course provides an introduction to formal concepts and methodologies used in support of technology planning, assessment and adoption - and related decision making - as part of cost-effective healthcare delivery. Open to participants in the Global Health Technologies Program only.

BMD_ENG 390-1 Biomedical Engineering Design (1 Unit)
Open-ended team-designed projects in the medical devices arena. Systems approach requiring design strategy and concepts, including reliability, safety, ethics, economic analysis, marketing, FDA regulations, and patents. Written and oral reports. Prerequisite: BMD_ENG 307-0.

BMD_ENG 390-2 Biomedical Engineering Design (1 Unit)
Development of a design project initiated during the previous quarter. Prerequisite: BMD_ENG 390-1.

BMD_ENG 390-3 Biomedical Engineering Design (1 Unit)
Continuation of a design project; independent study. May not be repeated for credit. Prerequisites: BMD_ENG 390-1 or BMD_ENG 390-2; consent of instructor.

BMD_ENG 391-SA HealthCare Technology Innovation and Design (1 Unit)
Principles and practice of medical device design for the developing world. Evaluation of user needs in the environment of under-resourced segments of South African health care system. Validation and verification of engineering design solutions. Open to participants in the Global Health Technologies Program only.

BMD_ENG 395-0 Topics in Biomedical Engineering (1 Unit)
Special Topics in Biomedical Engineering.

BMD_ENG 396-0 Special Topics (0.5 Unit)
Special Topics in Biomedical Engineering, Laboratory emphasis.

BMD_ENG 397-0 Special Topics (0.5-1 Unit)
Special Topics in Biomedical Engineering, Laboratory emphasis.

BMD_ENG 398-0 Special Topics in Biomedical Engineering (0.34 Unit)
Special Topics in Biomedical Engineering, Laboratory emphasis.

BMD_ENG 399-0 Projects (1 Unit)
Special Topics in Biomedical Engineering, Laboratory emphasis.