Biomedical Engineering

BMEN 5375 (EECS 5375 and MECH 5308) Introduction to Robotics (3 semester credit hours) Fundamentals of robotics, rigid motions, homogeneous transformations, forward and inverse kinematics, velocity kinematics, motion planning, trajectory generation, sensing, vision, and control. Prerequisites: ENGR 2300 and (EE 4310 or BMEN 4310 or MECH 4310) or equivalent. (2-3) Y

BMEN 6324 (EECS 6324 and MECH 6324) Robot Control (3 semester credit hours) Dynamics of robots; methods of control; force control; robust and adaptive control; feedback linearization; Lyapunov design methods; passivity and network control; control of multiple and redundant robots; teleoperation. Prerequisite: EECS 6331 or MECH 6300 or SYSM 6307. (3-0) T

BMEN 6341 Biostatistics (3 semester credit hours) Introduction to probability; joint, marginal and conditional distributions; entropy and relative entropy (Kullback-Leibler divergence); Markov processes and hidden Markov models; applications to specific problems such as sequence alignment, analysis of gene expression data and protein classification. (3-0) T

BMEN 6342 Biomaterials and Medical Devices (3 semester credit hours) Introduction to the field of biomaterials used in the design of medical devices and to augment/replace soft and hard tissues. Overview of current challenges and successes with implantable devices, biomaterials properties, clinical requirements, clinical applications and cases, and in-vivo behavior of different classes of natural and synthetic materials. Analysis of biological response and biocompatibility, degradation and failure processes of implantable biomaterials. Students will become familiar with several classes of biomaterials and their current clinical applications. (3-0) Y

BMEN 6345 Self-Assembly of Biomaterials (3 semester credit hours) This course will introduce students to the emerging and evolving fields of self-assembly and nanoengineered biomaterials. Upon completion of the course students will understand the principles of self-assembly and self-organization of small molecules (e.g. thiols and surfactants), macromolecules (e.g. polymers, block co-polymers, proteins, DNA), and colloidal dispersions. Students will also learn the important role weak non-covalent forces (e.g. ionic bonds, hydrogen bonding, hydrophobic interactions) play in determining the structure of self-assembled systems. Finally students will learn how scientists and engineers are designing and exploiting the principles of self-assembly to produce functional biomaterials and the techniques to characterize these biomaterials from the nano to macro level. Topics to be covered include the following: Introduction to Self-Assembly; Intermolecular and Colloidal forces; Self-assembly in solutions micelles, bilayers, liquid crystals, emulsions; Colloidal Self-Assembly; Self-Assembly at Interfaces; Biomimetic Self-Assembly; Nanoparticles; and Nanostructured Films. Prerequisites: BIOL 2311 and CHEM 1312 and MATH 2417 and PHYS 2325 and instructor consent required. (3-0) Y

BMEN 6351 Biomedical Microdevices (3 semester credit hours) Introduction to concepts of medical microdevices; design methodology and its applications for diagnostics and therapeutics. (3-0) Y

BMEN 6355 (MSEN 6355) Nanotechnology and Sensors (3 semester credit hours) Introduction to the concept of nanotechnology, in context toward designing sensors/diagnostic devices. Identifying the impact of nanotechnology in designing "state-of-the art" sensors for healthcare applications. Topics include:
nanotechnology and nanomaterials, principles of sensing and transduction and heterogeneous integration toward sensor design. (3-0) Y

**BMEN 6360** (CHEM 5340 and MSEN 5340) Advanced Polymer Science and Engineering (3 semester credit hours) Polymer structure-property relations, Glass transition temperature and mechanical properties of polymers, Thermoplastics, thermosets, and elastomers, morphology of polymers, rheology of polymers, biodegradable and biocompatible polymers for drug delivery and tissue engineering applications. (3-0) R

**BMEN 6372** (MECH 6314 and SYSM 6306) Engineering Systems: Modeling and Simulation (3 semester credit hours) This course will present principles of computational modeling and simulation of systems. General topics covered include: parametric and non-parametric modeling; system simulation; parameter estimation, linear regression and least squares; model structure and model validation through simulation; and, numerical issues in systems theory. Techniques covered include methods from numerical linear algebra, nonlinear programming and Monte Carlo simulation, with applications to general engineering systems. Modeling and simulation software is utilized (MATLAB/SIMULINK). (3-0) Y

**BMEN 6373** (EEBM 6373) Anatomy and Human Physiology for Engineers (3 semester credit hours) This course provides an introduction to anatomy and human physiology for engineers and other non-life scientists. Topics include nervous system, muscle and cardiac function, digestive system, and immune system. (3-0) Y

**BMEN 6374** (EEBM 6374) Genes, Proteins and Cell Biology for Engineers (3 semester credit hours) This course provides an introduction to principles of modern molecular and cellular biology for engineers and other non-life scientists. Topics include genes, protein structure and function, organization of cells and cellular trafficking. (3-0) Y

**BMEN 6375** Techniques in Cell and Molecular Biology (3 semester credit hours) Introduction to cell and molecular laboratory techniques including DNA recombinant technology, protein biochemistry, structural biology, and molecular biology. Intended for engineers and other non-life-scientists. Prerequisite: **BMEN 6374** or instructor consent required. (3-0) Y

**BMEN 6376** (EEBM 6376) Lecture Course in Biomedical Applications of Electrical Engineering (3 semester credit hours) This course provides an introduction to different areas of biomedical applications of electrical engineering. A special emphasis will be placed on research topics that are actively pursued at UT Dallas. (3-0) Y

**BMEN 6377** Introduction to Protein Engineering (3 semester credit hours) Development of proteins with practical utility will be discussed, using examples and case studies taken from the current literature. Prerequisite: **BMEN 6374** or instructor consent required. (3-0) Y

**BMEN 6378** Mechanobiology for Engineers (3 semester credit hours) This course will introduce principles by which mechanical forces regulate biological processes in cells and tissues in healthy and diseased states. In order to understand mechanobiology from an engineering perspective, this course will review aspects of solid and fluid mechanics, cell biology, intracellular polymer mechanics, cellular mechanics and mechanotransduction, disease mechanisms, biological modeling and research methodology. In addition, the impact of mechanobiology in bone, arteries and various cell types will be discussed. (3-0) T

**BMEN 6380** (EEBM 6380) Introduction to Cellular Microscopy (3 semester credit hours) Image formation,
diffraction, labeling techniques, fluorescence and image processing techniques will be introduced. (3-0) Y

**BMEN 6381** (EEBM 6381) Advanced Concepts in Microscopy (3 semester credit hours) Continuation of BMEN 6380, with emphasis on advanced approaches such as vectorial diffraction, stochastic aspects of image formation and analysis. Prerequisite: BMEN 6380 or EEBM 6380 or instructor consent required. (3-0) Y

**BMEN 6382** Systems Biology (3 semester credit hours) An interdisciplinary approach to biology. It explores experimental, theoretical, and computational approaches from mathematics, physics, and engineering for the understanding and analysis of biological problems. Prerequisite: BMEN 6374 or instructor consent required. (3-0) Y

**BMEN 6385** Biomedical Signals and Systems (3 semester credit hours) Time and Frequency domain analysis; continuous-time and discrete-time signals, linear-time invariant (LTI) systems and their properties. Frequency analysis of: LTI systems, continuous-time signals (Fourier series and Fourier transform) and discrete time signals [discrete Fourier series and discrete-time Fourier transform (DTFT)]. Sampling and signal reconstruction. Discrete Fourier transform (DFT) and fast Fourier transform (FFT). Filter design. MATLAB-based tutorials. Prerequisites: ENGR 2300 and EE 4310. (3-0) Y

**BMEN 6386** Biological Processes: Modeling and Simulation (3 semester credit hours) Introduces fundamental principles to develop and simulate mathematical and computer models of biological systems. Topics include modeling principles [continuous (differential equation models), discrete (Boolean network and Markov model), probabilistic (Bayesian network) and stochastic models] and model optimization. Methods to simulate mathematical biological models using computer programming (software: MATLAB) will be introduced. Prerequisite: MATH 2419 or equivalent. (3-1) Y

**BMEN 6387** (BIOL 5376) Applied Bioinformatics (3 semester credit hours) Genomic information content; data searches and multiple sequence alignment; mutations and distance-based phylogenetic analysis; genomics and gene recognition; polymorphisms and forensic applications; nucleic-acid and protein array analysis; structure prediction of biological macromolecules. Prerequisites: At least one semester of undergraduate statistics and probability, and two semesters of undergraduate calculus or instructor consent required. (3-0) T

**BMEN 6388** (EECS 6336 and MECH 6313 and SYSE 6324) Nonlinear Systems (3 semester credit hours) Differential geometric tools, feedback linearization, input-output linearization, output injection, output tracking, stability. Prerequisite: EECS 6331 or MECH 6300 or SYSM 6307 or equivalent. (3-0) T

**BMEN 6389** (BIOL 6385) Computational Biology (3 semester credit hours) Machine learning and probabilistic graphical models have become essential tools for analyzing and understanding complex systems biology data in biomedical research. This course introduces fundamental principles and methods behind the most important high throughput data analysis tools. Applications will cover molecular evolutionary models, DNA/protein motif discovery, gene prediction, high-throughput sequencing and microarray data analysis, computational modeling gene expression regulation, and biological pathway and network analysis. Prerequisite: Some background in elementary statistics/probability or introductory bioinformatics, or instructor consent required. (3-0) Y

**BMEN 6390** (BIOL 6390) Metabolic Pathways for Translational Medicine (3 semester credit hours) This course will provide extensive discussion of major metabolic pathways in human and other experimental models of human diseases with emphasis on biochemical understanding, roles and effects of the
pathways in the entire cellular network, and potential application to medicine. Prerequisite: BMEN 6389 or BIOL 6385 or instructor consent required. (3-0) T

**BMEN 6391 (BIOL 6373)** Proteomics (3 semester credit hours) Protein identification, sequencing, and analysis of post-translational modifications by liquid chromatography/tandem mass spectrometry; determination of protein three dimensional structure by x-ray crystallography; its use in drug design; understanding protein interactions and function using protein chip microarrays. Prerequisites: one semester of undergraduate biochemistry and one semester of graduate biochemistry or instructor consent required. (3-0) T

**BMEN 6392** Bioinstrumentation and Systems (3 semester credit hours) Introduction to bioinstrumentation, biomedical signal acquisition, isolation, amplification, and conditioning, biopotential electrodes and amplifiers for ECG, EEG, ENG and EMG. Vascular system dynamics. Transmission and propagation of EM and RF signals around tissue. Biomedical applications. Prerequisite: BMEN 6385. (3-0) Y

**BMEN 6V40** Individual Instruction in Biomedical Engineering (1-9 semester credit hours) May be repeated for credit. Department consent required. ([1-9]-0) R

**BMEN 6V70** Research in Biomedical Engineering (3-9 semester credit hours) Pass/Fail only. May be repeated for credit. Instructor consent required. ([3-9]-0) R

**BMEN 6V71** Seminars in Biomedical Engineering (1-3 semester credit hours) Pass/Fail only. May be repeated for credit. Department consent required. ([1-3]-0) R

**BMEN 6V87** Special Topics in Biomedical Engineering (1-9 semester credit hours) May be repeated for credit. Department consent required. ([1-9]-0) S

**BMEN 6V98** Thesis (3-9 semester credit hours) Pass/Fail only. May be repeated for credit. Instructor consent required. ([3-9]-0) S

**BMEN 7188** Advanced Seminars in Biomedical Engineering (1 semester credit hour) Selected topics in biomedical engineering. May be repeated for credit (3 semester credit hours maximum). Department consent required. (1-0) R

**BMEN 7V87** Advanced Topics in Biomedical Engineering (1-9 semester credit hours) Independent scientific research in Bioengineering. May be repeated for credit as topics vary. Department consent required. ([1-9]-0) S

**BMEN 8V40** Advanced Instruction in Biomedical Engineering (1-9 semester credit hours) Advanced research in biomedical engineering. Pass/Fail only. May be repeated for credit. Department consent required. ([1-9]-0) R

**BMEN 8V70** Advanced Research In Biomedical Engineering (3-9 semester credit hours) Pass/Fail only. May be repeated for credit. Instructor consent required. ([3-9]-0) R

**BMEN 8V99** Dissertation (3-9 semester credit hours) Pass/Fail only. May be repeated for credit. Instructor consent required. ([3-9]-0) S