

**REQUIREMENTS FOR THE COMBINED FIVE-YEAR DEGREE PLAN
BACHELOR OF SCIENCE IN BIOLOGY AND
MASTER OF SCIENCE IN BIOMEDICAL ENGINEERING
2005
COLLEGE OF ENGINEERING
UNIVERSITY OF TEXAS AT ARLINGTON**

**General Requirements
Total Credit Hours = 163**

FRESHMAN								
FIRST SEMESTER			Hours	SECOND SEMESTER			Hours	
MATH 1426	Calculus I		4	ENGL 1301	Critical Thinking, Reading and Writing I		3	
BIOL 1441	Cell & Molecular Biology		4	MATH 2425	Calculus II		4	
CHEM 1441	General Chemistry I w/ Lab		4	BIOL 1442	Structure & Function of Organisms		4	
BME 1225	Intro to Biomedical Engineering		2	CHEM 1442	General Chemistry II w/ Lab		4	
POLS 2311	US Government		3	POLS 2312	State & Local Government		3	
TOTAL CREDIT HOURS			17	TOTAL CREDIT HOURS			18	
SOPHOMORE								
FIRST SEMESTER			Hours	SECOND SEMESTER			Hours	
ENGL 1302	Critical Thinking, Reading and Writing II		3	MATH 3319	Diff Equations & Linear Algebra		3	
MATH 2326	Calculus III		3	CHEM 2182	Organic Chemistry II Lab		1	
CHEM 2181	Organic Chemistry I Lab		1	CHEM 2322	Organic Chemistry II		3	
CHEM 2321	Organic Chemistry I		3	PHYS 1444	Technical Physics II (w/Lab)		4	
PHYS 1443	Technical Physics I (w/ Lab)		4	HIST 1312	U.S. History since 1865		3	
HIST 1311	U.S. History to 1865		3	■ Fine Arts Elective			3	
TOTAL CREDIT HOURS			17	TOTAL CREDIT HOURS			17	
JUNIOR								
FIRST SEMESTER		Hrs	SECOND SEMESTER		Hrs	SUMMER SEMESTER		Hrs
BIOL 3301	Cell Physiology	3	BIOL 3444	General Microbiology	4	BME 5309D	Human Physiology	3
CE 2312	Statics & Dynamics	3	BIOL 3315	Genetics	3			
CSE 1310	Intro to computer & Programming	3	EE 2320	Circuit Analysis	3			
MAE 3310	Thermodynamics*	3	MAE 2314	Fluid Mechanics	3			
■ Social/Cultural Elective		3	MAE 2381	Exp Methods & Measures Lab I	3			
			■ Literature Elective		3			
TOTAL CREDIT HOURS		15	TOTAL CREDIT HOURS		19	TOTAL CREDIT HOURS		3
SENIOR								
FIRST SEMESTER		Hrs	SECOND SEMESTER		Hrs	SUMMER SEMESTER		Hrs
BIOL 3312	Immunobiology	3	BIOL 4346	Techniques in Microbial & Molecular Genetics	3	BME 5365	Tissue Engineering Lab	3
CHEM 4311	Biochemistry I	3	MAE 3319	Dynamic Systems Modeling & Simulation	3			
MAE 3183	Measurements Lab2	1	MAE 4345	Intro to Robotics*	3			
MAE 3317	Linear Systems	3	BIOL 3310	Tissue Culture & Appl	3			
BME 5364	Tissue Engineering Lecture	3						
BIOL 3305	Tech Writing*	3						
TOTAL CREDIT HOURS		16	TOTAL CREDIT HOURS		15	TOTAL CREDIT HOURS		3
Fifth Year								
FIRST SEMESTER			Hours	SECOND SEMESTER			Hours	
BIOL 5314	Biometry		3	BME 5293	MS Comprehensive Examination		2	
BME 4325	Fundamentals of Biomedical Engr		3	BME 5382	Laboratory Principles		3	
BME 5335	Biological Materials, Mechanics and Processes		3	BME 5366	Process Control in Biotechnology		3	
BME 5361	Biomaterials & Blood Compatibility		3	BME 5390	Research Project in BME		3	
TOTAL CREDIT HOURS			12	TOTAL CREDIT HOURS			11	

After completion of first semester in Junior year, students are eligible to submit application for Graduate School Admission in order to take graduate level courses.

■ To be chosen from the approved list of electives available in the BME office, 220 ELB.

(*) Can substitute: MAE 3310 with CHEM 3321; BIOL 3305 with SPCH 3302; MAE 3317 with EE 3317; MAE 4345 with EE 4315;

(**) Students who do not have two units of a single foreign language in high school will be required to take two courses of a single foreign language in addition to the previously listed curriculum requirements.

COURSES IN BIOLOGY (BIOL)

BIOL 1441. CELL AND MOLECULAR BIOLOGY (3-2) 4 hours credit. (BIOL 1406) The first of a three-part introductory biology sequence, this course focuses on the chemical and molecular basis of life, including metabolism, cell structure and function, and genetics. Laboratory experiments are designed to complement theory presented in lecture. Formerly listed as BIOL 1449; credit will not be given for both.

BIOL 1442. STRUCTURE AND FUNCTION OF ORGANISMS (3-2) 4 hours credit. The study of structure and function in plants and animals. Topics to be covered include structure at the level of the cell, tissue, organ and individual growth, transport/circulation/gas exchange, nutrition, reproduction, development, endocrinology, and animal neural regulation. The laboratory will examine plant and animal structure and function with observational and experimental approaches. **Semesters offered:** Fa **Prerequisite:** BIOL 1441.

BIOL 3301. CELL PHYSIOLOGY (3-0) 3 hours credit. An introduction to the basic physical, chemical, and biological principles which govern function in eukaryotic cells, and the relationships between cells and their environments. **Semesters offered:** Fa **Prerequisite:** BIOL 1441, 1442 and 2343. CHEM 2181 and 2321 are recommended.

BIOL 3310. SELECTED TOPICS IN BIOLOGY (3-0) hours credit. Topics in biology not treated in the regular curriculum. Topic, format, and prerequisites to be determined by the instructor. May be repeated for biology elective credit as different topics are offered.

BIOL 3312. IMMUNOBIOLOGY (3-0) 3 hours credit. An introduction to the components, properties, and manifestations of the adaptive immune response that occurs in vertebrates. **Semesters offered:** Fa **Prerequisite:** BIOL 1441, 3444. CHEM 2181, 2321 are recommended.

BIOL 3315. GENETICS (3-0) 3 hours credit. Principles of molecular and classical genetics. The function and transmission of hereditary material in microorganisms, plants, and animals, including humans. **Semesters offered:** Fa **Prerequisite:** BIOL 1441, 1442 and 2343.

BIOL 3444. GENERAL MICROBIOLOGY (3-3) 4 hours credit. Fundamental principals of microbiology including the structure and function of microbial cells and their activities in nature. Bacteria will be used in the laboratory to provide training and experimental methodology. Formerly listed as BIOL 2451; credit will not be granted for both. **Semesters offered:** Fa **Prerequisite:** BIOL 1441 and one year of chemistry.

BIOL 4346. TECHNIQUES IN MICROBIAL AND MOLECULAR GENETICS (1-5) 3 hours credit. A laboratory based techniques course focusing on current methods in microbial and molecular genetics. Students will design experiments and perform: bacterial mutagenesis and phage transduction; selection, screening and physical mapping of mutants; blots, plasmid manipulations including purification, digestion, subcloning, bacterial transformations; PCR and DNA sequencing. **Semesters offered:** Irreg **Prerequisite:** BIOL 1441, 3444 and 3315 or permission of instructor.

BIOL 5314. BIOMETRY 3 hours credit. An examination of statistical methods and procedures in relation to the design of biological experiments and the analysis of their results. Prerequisites: consent of the instructor.

COURSES IN BIOMEDICAL ENGINEERING (BME)

BME 1225. INTRODUCTION TO BIOMEDICAL ENGINEERING (3-0) 3 hours credit. Topics include introduction to basic engineering principles and quantitative methods, their applications in analyzing and solving problems in biology and medicine. Also includes new trends in the development of biomedical engineering and biotechnology. Course includes visits to the area hospitals and bioengineering industry.

BME 4325. FUNDAMENTALS OF BIOMEDICAL ENGINEERING (3-0) 3 hours credit. Consists of lectures to cover the current development in various biomedical engineering research areas: including medical imaging, instrumentation, biomechanics, tissue engineering, artificial organs, biomaterials, and functional genomics, etc. Lecturers include faculty, guest speakers from area medical centers, hospitals, and the bioengineering industry who will cover their respective research areas.

BME 5293. MASTER'S COMPREHENSIVE EXAMINATION (3-0) 3 hours credit. Individual instruction, directed study, consultation, and comprehensive examination over coursework leading to the Thesis-Substitute Master of Science degree in biomedical engineering. Required of all Thesis-Substitute MS students.

BME 5309D. HUMAN PHYSIOLOGY (3-0) 3 hours credit. This course offers a comprehensive study of the basic physiological principles dealing with body systems and their interrelationships.

BME 5335. BIOLOGICAL MATERIALS, MECHANICS, AND PROCESSES (3-0) 3 hours credit. This course offers a study of typical, functional behavior of various biological materials, flow properties of blood, bioviscoelastic fluids and solids, and mass transfer in biological systems.

BME 5361. BIOMATERIALS AND BLOOD COMPATIBILITY (3-0) 3 hours credit. This course is an introduction to polymer structure and fabrication methods. Blood and tissue interactions with materials and methods to improve biocompatibility of materials are discussed.

BME 5364. TISSUE ENGINEERING LECTURE (3-0) 3 hours credit. Fundamentals of cell/extracellular matrix interactions in terms of cell spreading, migration, proliferation and function. Soft and hard tissue wound healing. Nerve regeneration. Polymer scaffolding materials and fabrication methods. Cell-polymer interactions, in vitro and in vivo. Tissue culture, hybrid organ synthesis and organ replacement.

BME 5365. TISSUE ENGINEERING LAB (3-0) 3 hours credit. Polymer extrusion, polymer drug loading, and polymer degradation with drug release. Each student will be given the opportunity to perform these experiments, including the culture of cells, testing for cell growth, proliferation and function under various substrate and media conditions. **Prerequisite:** BME 5364 or consent of the instructor.

BME 5366. PROCESS CONTROL IN BIOTECHNOLOGY (3-0) 3 hours credit. Principles and methods of measurement, data acquisition and analysis. Application of control theory in biological systems and in biotechnology processes; control of pressure, flow, temperature, and pH. **Prerequisite:** An undergraduate course in control theory or consent of the instructor.

BME 5382. LABORATORY PRINCIPLES (3-0) 3 hours credit. This course is an introduction to fundamental biomedical-engineering laboratory procedures, including human and animal studies. Data collection, analysis, and interpretation are emphasized.

BME 5390. RESEARCH PROJECT IN BIOMEDICAL ENGINEERING (3-0) 3 hours credit. This course requires student to conduct a research project and write a project report under the supervision of a faculty member.

COURSES IN CHEMISTRY & BIOCHEMISTRY (CHEM)

CHEM 1441. GENERAL CHEMISTRY (3-4) 4 hours credit. (CHEM 1412). The lecture covers the fundamentals of atomic structure, chemical bonding, the periodic table, nomenclature, kinetic theory, gas laws, chemical equations, and solutions. The laboratory introduces the scientific method, experiment design, data collection and analysis, as well as illustrates fundamental principles presented in the lecture. Students who have not had high school chemistry are advised to take CHEM 1300 first. **Semesters offered:** Fa **Prerequisite:** MATH 1302 or equivalent

CHEM 1442. GENERAL CHEMISTRY (3-4) 4 hours credit. (CHEM 1412). Study of advanced atomic structure and bonding concepts, acid-base theory, kinetics and equilibria, thermodynamics, electrochemistry, the chemistry of some elements. The laboratory focuses on experimental design, data collection and analyses as well as chemical syntheses to illustrate fundamental principles presented in the lecture. **Semesters offered:** Fa **Prerequisite:** CHEM 1441 or the equivalent, which may include satisfactory grade on the Advanced Standing Examination offered through the Office of Measurement and Testing Services

CHEM 2181. ORGANIC CHEMISTRY LABORATORY (0-4) 1 hours credit. Experiments which illustrate laboratory techniques, theoretical concepts, and synthesis. **Semesters offered:** Fa **Prerequisite:** CHEM 1442 (or 1284 and 1302). Co-requisite: CHEM 2321. If CHEM 2321 is being taken concurrently with 2181 and the student withdraws from 2321 before the midsemester date, he/she must also withdraw from 2181

CHEM 2182. ORGANIC CHEMISTRY LABORATORY (0-4) 1 hours credit. Experiments which will include syntheses, characterization of unknown substances, and use of the chemical literature. **Semesters offered:** Fa **Prerequisite:** CHEM 2181. Co-requisite: CHEM 2322. If CHEM 2322 is being taken concurrently with 2182 and the student withdraws from 2322 before the midsemester date, he/she must also withdraw from 2182

CHEM 2321. ORGANIC CHEMISTRY (3-0) 3 hours credit. (CHEM 2423). The fundamentals of molecular structure, stereochemistry, and the reactions of aliphatic hydrocarbons. Electronic theory, synthetic methods, and mechanisms. **Semesters offered:** Fa **Prerequisite:** CHEM 1442 or CHEM 1302

CHEM 2322. ORGANIC CHEMISTRY (3-0) 3 hours credit. (CHEM 2425). Organic spectroscopic analysis. The chemistry of aromatic hydrocarbons, alcohols and ethers, aldehydes, ketones, carboxylic acids and derivatives, amines, amino acid, carbohydrates, and other functional groups. Mechanisms and synthesis. **Semesters offered:** Fa **Prerequisite:** CHEM 2321

CHEM 3321. PHYSICAL CHEMISTRY (3-0) 3 hours credit. Solids, liquids, and gases, thermochemistry, thermodynamics, solutions, equilibria, and electrochemistry. **Semesters offered:** Fa **Prerequisite:** CHEM 2335, eight hours of physics, and MATH 2326. Concurrent enrollment in MATH 3318 is encouraged.

CHEM 4311. GENERAL BIOCHEMISTRY (3-0) 3 hours credit. The chemistry of the sugars, amino acids, proteins, and nucleic acids, followed by an introduction to enzyme chemistry. The major metabolic pathways of the cell, glycolysis, TCA cycle, and pentose phosphate pathway. Auditing of this class is NOT permitted. **Semesters offered:** Fa **Prerequisite:** CHEM 2322

COURSES IN CIVIL ENGINEERING (CE)

CE 2312. STATICS AND DYNAMICS (2-2) 3 hours credit. The lecture covers principles of forces and force systems, resultants and components of force systems, forces due to friction, condition of equilibrium, forces acting on members of trusses and frame structures, centroids and moments of inertia, review of kinematics and kinetics of particle motion, and two-dimensional motion of rigid bodies. The lab period is used for reinforcement of the course principles through problem solving as well as computer simulation demonstrations. **Prerequisite:** PHYS 1443; and MATH 2425 or concurrent registration therein.

COURSES IN COMPUTER SCIENCE AND ENGINEERING (CSE)

EE 1310. INTRODUCTION TO COMPUTERS AND PROGRAMMING (3-1) 3 hours credit. An introduction to the computer, to the algorithmic process, and to programming in C using standard control structures. Windows and UNIX operating systems are used. **Prerequisite:** MATH 1302 (or concurrently).

COURSES IN ELECTRICAL ENGINEERING (EE)

EE 2320. CIRCUIT ANALYSIS (3-0) 3 hours credit. For non-electrical engineering majors. Basic principles of R, L, and C components. Kirchoff's laws, network analysis, loop and node equations, basic network theorems. Steady-state AC phasor analysis, operational amplifiers, filtering, and digital circuits. **Prerequisite:** Math 2425, PHYS 1444.

EE 3317. LINEAR SYSTEMS (3-0) 3 hours credit. Time-domain transient analysis, convolution, Fourier Series and Transforms, Laplace Transforms and applications, transfer functions, signal flow diagrams, Bode plots, stability criteria, and sampling. **Prerequisite:** EE 2446 and MATH 3319

EE 4315. ROBOTICS (3-0) 3 hours credit. Principles of kinematics, dynamics, and control of industrial robots. Robot sensors and actuators. Applications in manufacturing, path planning, and programming. **Prerequisite:** EE 4314

COURSES IN MATHEMATICS (MATH)

MATH 1426. CALCULUS I (3-2) 4 hours credit. (MATH 2413). Concepts of limit, continuity, differentiation and integration; applications of these concepts. **Prerequisite:** MATH 1323 or MATH 1325.

MATH 2326. CALCULUS III (3-0) 3 hours credit. (MATH 2315). Partial differentiation, multiple integrals (with applications), line integrals, Green's Theorem, surface integrals, Stokes' Theorem, divergence theorem. **Prerequisite:** MATH 2425.

MATH 2425. CALCULUS II (3-2) 4 hours credit. (MATH 2314). Applications of integration, techniques of integration, parametric equations, polar coordinates, sequences and series. **Prerequisite:** MATH 1426.

MATH 3319. DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA (3-0) 3 hours credit. Introductory course with emphasis on solution techniques. Ordinary differential equations, vector spaces, linear transformations, matrix/vector algebra, eigenvectors, Laplace Transform, and systems of equations. **Prerequisite:** MATH 2326 or concurrent registration.

COURSES IN MECHANICAL ENGINEERING (MAE)

MAE 2314. FLUID MECHANICS I (3-0) 3 hours credit. Fundamental concepts of fluid mechanics leading to the development of both the integral and differential forms of the basic conservation equations. Application of the integral conservation equations to engineering problems in fluid dynamics including buoyancy and other hydrostatics problems. Dimensional analysis and similitude are also discussed. **Semesters offered:** Fa **Prerequisite:** MAE 2323, MATH 2326 or concurrent enrollment, and MAE 3310 or concurrent enrollment.

MAE 2381. EXPERIMENTAL METHODS AND MEASUREMENTS (2-3) 3 hours credit. Introduction to data analysis, incorporating statistics and probability, design and planning of engineering experiments for error prediction and control. Measurement and instrumentation, basic instruments, their calibration and use. **Semesters offered:** Fa **Prerequisite:** MATH 2425

MAE 3183. MEASUREMENTS LABORATORY II (0-3) 1 hours credit. Fundamental measurement techniques in mechanical engineering in the fields of thermal/fluid sciences, energy conversion, design, and systems control. Introduction of advanced instrumentation concepts. **Semesters offered:** Fa **Prerequisite:** MAE 1312, 2381, 2314, 3314, 3319, and EE 2320 (or concurrent enrollment)

MAE 3310. THERMODYNAMICS I (3-0) 3 hours credit. Basic concepts and definitions, properties of pure substance, work and heat, first law of thermodynamics, second law of thermodynamics, entropy, thermodynamics of gases, vapors, and liquids in various nonflow and flow processes, and irreversibility and availability. **Semesters offered:** Fa **Prerequisite:** MATH 2425 or 2525; PHYS 1444; MAE 2360; and CE 2312, or MAE 2322, or MAE 1312.

MAE 3314. HEAT TRANSFER (3-0) 3 hours credit. The fundamental laws of heat and mass transfer, including steady and unsteady conduction, convection, and radiation. Applications of heat transfer to thermal systems design are included. **Semesters offered:** Fa **Prerequisite:** MAE 3360, 2314, 3311.

MAE 3317. LINEAR SYSTEMS (3-0) 3 hours credit. Time-domain transient analysis, convolution, Fourier Series and transforms, Laplace transforms and applications, transfer functions, signal flow diagrams, Bode plots, stability criteria, sampling, and Z-transforms. **Prerequisite:** MAE 3360. Also taught as EE 3317.

MAE 3319. DYNAMIC SYSTEMS MODELING AND SIMULATION (3-0) 3 hours credit. Introduction to modeling and prediction of behavior of engineering systems. Analytic and numerical simulation, state-space differential equations, and Laplace transform methods. Effects of physical characteristics of system elements on system design and dynamic performance. **Semesters offered:** Fa **Prerequisite:** MAE 2360, 2323, 3310, 3360. Concurrent enrollment: MAE 2314 and 3314; EE 2320.

MAE 4345. INTRODUCTION TO ROBOTICS (3-0) 3 hours credit. Overview of industrial robots. Principles of kinematics, dynamics, control as applied to robotic systems; robotic sensors and actuators; path planning; programming an industrial robot in the laboratory; survey of application of robots in manufacturing; and guidelines to robot arm selection. **Prerequisite:** MAE 3318, 3319. Concurrent enrollment: MAE 4310. Senior level standing or consent of the instructor. Also offered as EE 4315.

COURSES IN PHYSICS (PHYS)

PHYS 1443. GENERAL TECHNICAL PHYSICS I (3-3) 4 hours credit. (PHYS 2425). The first half of a one-year technical course. Required for many science and engineering majors, exceeds premedical requirement. The study of physical phenomena in the fields of mechanics, heat, and waves. **Prerequisite:** MATH 1426 or concurrent enrollment.

PHYS 1444. GENERAL TECHNICAL PHYSICS II (3-3) 4 hours credit. (PHYS 2426). The second half of a one-year technical course. The study of physical phenomena including electricity, magnetism, circuit theory, light, and optics. **Prerequisite:** PHYS 1443 and MATH 2325 or concurrent enrollment.