BIOMEDICAL ENGINEERING DEPARTMENT

BIOMEDICAL ENGINEERING PROGRAM

Biomedical engineering applies engineering principles and design concepts together with knowledge of biology and medicine, with the aim of providing alternative or improved methods and procedures of health care, either for diagnostic or treatment purposes. As a multidisciplinary field, it involves aspects of other engineering disciplines such as chemical engineering, computer engineering, electrical engineering and mechanical engineering combined with mathematics, chemistry, biology, and medicine which are integrated to improve human quality of life.

Sub-disciplines in biomedical engineering are the design of active and passive medical devices (pacemakers, prosthetic limbs, orthopedic implants, etc.,) medical imaging, biomedical signal processing, tissue and stem cell engineering, clinical engineering, and other engineering sub-specializations. Other areas include life science industry manufacturing processes, hospital facilities maintenance, bioinformatics, rehabilitation and sports engineering. These areas deliver important breakthroughs that make healthcare and medicine more effective and efficient.

Program Mission

The Biomedical Engineering Program at Polytechnic University of Puerto Rico is designed to "develop graduates from different backgrounds and in different locations, to cultivate their potential for leadership, productivity, competitiveness and critical thinking, through exposure to intellectual, scientific, humanistic and technological advancement, with the purpose of contributing to regional and global sustainability."

Program Educational Objectives

Upon a few years of graduation, PUPR's biomedical engineering graduates are expected to:

1. Work with professionalism and high ethical standards as biomedical engineers in the life science industry, including pharmaceutical and medical devices, or in the healthcare industry, including hospitals, clinics, and rehabilitation, and training centers.
2. Continue studies in engineering or medicine, or perform graduate studies in related disciplines.

Student Outcomes

Graduates from the Biomedical Engineering Program shall be able to:

a. Apply knowledge of mathematics, science, and engineering.
b. Design and conduct experiments, as well as to analyze and interpret data.
c. Design a system, component, or process to meet desired needs.
d. Function or multidisciplinary teams.
e. Identify, formulate, and solve engineering problems.
f. Understand professional and ethical responsibilities.
g. Communicate effectively.
h. Understand the impact of engineering solutions in a global and societal context.
i. Recognize the need for and engage in lifelong learning.
j. Understand contemporary engineering issues.
k. Use the techniques, skills, and modern engineering tools necessary for engineering practice.

Career Opportunities

Biomedical engineers have many professional options due to the breadth of their preparation. Biomedical engineers can pursue their careers with local, state, and federal agencies, as well as with private enterprises, or start their own businesses and/or pursue graduate studies. Graduates from this program have found successful careers in a variety of industries such as medical devices, pharmaceuticals, biotechnology, hospitals, food industry, and biomedical services, among others. Biomedical engineers may pursue graduate studies in biomedical engineering, medicine, and dentistry.

Degree Offered

The Biomedical Engineering Program offers undergraduate instruction leading to the degree of Bachelor of Science in Biomedical Engineering (B.S.B.M.E.). To obtain the degree, the student must complete the following minimum requirements:

Minimum Graduation Requirements

15	Credit-hours in Mathematics
16	Credit-hours in Chemistry
8	Credit-hours in Biology
10	Credit-hours in Physics
6	Credit-hours in Social Science
9	Credit-hours in Spanish
9	Credit-hours in English
12	Credit-hours in Engineering
54	Credit-hours in BME Core
6	Credit-hours in Tech. Electives
6	Credit-hours in Free Electives
151	**Total Credit-Hours**

If the student decides to have the necessary credits to pursue further studies in Medicine or Dental School, he/she has to enroll in the following elective courses: 3 credits – Spanish; 3 credits – English; and 6 credits in specific socio-humanistic courses. Free electives can be used to complete the Spanish and English requirements. The specific socio-humanistic courses needed to have the requisites to pursue M.D. are in the areas of economy, psychology, political science, sociology and/or anthropology. There are six credits in the program that students may choose to complete these requirements.

Development Studies

Students admitted to the Biomedical Engineering Program must show evidence that they have acquired the academic abilities necessary to progress through this major. Those not demonstrating these abilities, as reflected by the results of their College Entrance Examination Board Test, PUPR's placement test, or previous university experience, are required to take developmental courses. These courses are designed to help students overcome deficiencies in languages, mathematics, and science. These courses are required in addition to the 151 credit hours required by the Biomedical Engineering Program.

Developmental Studies Component

(Maximum of 33 Credit-Hours)

Course		Title	Credit-Hours
MATH	0102	Preparatory Mathematics	3
MATH	0106	Elementary Algebra	3
MATH	0110	Intermediate Algebra	3
MATH	1330	Pre-calculus I	3
MATH	1340	Pre-calculus II	3
SCIE	0110	Introduction to Physics	3
ATUL	0100	Adjustment to University Life	3
ENGL	0100	Preparatory English	3
ENGL	0110	English Grammar	3
SPAN	0100	Preparatory Spanish	3
SPAN	0110	Spanish Grammar	3
		Total	**33**

Laboratories

The facilities and laboratories of the Biomedical Engineering Program at PUPR provide students with hands-on experience on several important areas such as computer-aided design, computer programming, biomechanics, Biosystems circuits and electronics, and the

rehabilitation and industrial automation laboratories. The biomedical engineering experimental facilities are housed on the fourth floor of the Pavilion building. In addition, chemistry, physics, electronics and computers laboratories are also available throughout the campus.

Student Organizations

The Biomedical Engineering Program encourages its students to participate actively in the following student organizations:

a. College of Engineers and Land Surveyors of Puerto Rico (CIAPR)
b. Biomedical Engineering Society
c. American Institute of Medical and Biological Engineering (AIMBE)
d. IEEE Engineering in Medicine and Biology (EMB) Society
e. AiCHE Society of Biological Engineering
f. ASME Bioengineering Division
g. Engineering World Health

These organizations provide students with the opportunity to get acquainted with their career and participate in conferences, seminars, and field trips to broaden their professional and social activities and nurture their leadership and communications skills.

BIOMEDICAL ENGINEERING PROGRAM CURRICULUM STRUCTURE

Mathematics Component

(15 Credit-Hours)

Course		Title	Credit-Hours
MATH	1350	Calculus I	4
MATH	1360	Calculus II	4
MATH	1370	Calculus III	4
MATH	3310	Differential Equations	3
		Total	**15**

Science Component

(34 Credit-Hours)

Course		Title	Credit- Hours
SCIE	1130	Biology I	4
SCIE	1131	Biology I Laboratory	0
SCIE	1140	Biology II	4
SCIE	1141	Biology II Laboratory	0
SCIE	1214	General Chemistry I	4
SCIE	1215	General Chemistry I Laboratory	0
SCIE	1220	General Chemistry II	4
SCIE	1221	General Chemistry II Laboratory	0
SCIE	1230	Organic Chemistry I	4
SCIE	1231	Organic Chemistry I Laboratory	0
SCIE	1240	Organic Chemistry II	4
SCIE	1241	Organic Chemistry II Laboratory	0
SCIE	1430	Physics I, Mechanics	4
SCIE	1431	Physics I Laboratory I	1
SCIE	1440	Physics II	4
SCIE	1441	Physics II Laboratory	0
		Total	**34**

Socio-Humanistic Studies and Languages Component

(18 Credit-Hours)

Course		Title	Credit-Hours
ENGL	1010	The Study of the Essay as a Literary Genre	3
ENGL	2020	Business English and Communication	3

ENGL	2030	Medical Terminology	3
SPAN	1010	Linguistic Analysis of Literary Genres	3
SPAN	2010	Hispanic Literature	3
SPAN	2020	Business Spanish	3
		Total	**18**

Socio-Humanistic Studies and Languages
Pre-Med Electives Component
(6 Credit-Hours)

Course		Title	Credit-Hours
ECON	3010	Micro-Economics	3
ECON	3020	Macro-Economics	3
PSYC	3020	Human Development	3
PSYC	3040	Abnormal Psychology	3
PSYC	3050	Theories of Personality	3
		Total	**6**

Engineering Science Component
(12 Credit-Hours)

Course		Title	Credit-Hours
ENGI	2910	Engineering Mechanics, Statics and Dynamics	3
ENGI	3440	Thermo-Fluid Mechanics	3
EE	3000	Circuit Analysis I	3
ENGI	2270	Engineering Probability and Statistics	3
		Total	**12**

Biomedical Engineering Component
(54 Credit-Hours)

Course		Title	Credit-Hours
BME	1010	Introduction to Biomedical Engineering	3
BME	2110	Computer Aided Drafting and Design for BME	3
BME	3010	Computer Programming for BME	3
BME	3120	Biomaterials	3
BME	3130	Fundamentals of Biomechanics	3
BME	3220	Fundamentals of Electronics	3
BME	3140	Transport Phenomena in Biological Systems	3
BME	3230	Biomedical Signals and Systems	3
BME	3150	Life Science Industry Manufacturing Processes	3
BME	3020	Physiological Modeling and Control Systems	3
BME	3131	Fundamentals of Biomechanics Lab.	1
BME	4020	Regulations in the Life Science Industry	3
BME	3221	Bio-system Circuits and Electronics Lab	1
BME	4230	Bioinstrumentation	3
BME	4011	Rehabilitation Engineering Lab	1
BME	4210	Health Care Information Systems	3
BME	4030	Clinical Engineering	3
BME	4992	Biomedical Engineering Capstone Design I	3
BME	4994	Biomedical Engineering Capstone Design II	3
		Total	**54**

Elective Courses Component
(12 Credit-Hours)

Course		Title	Credit-Hours
BME	XXXX	Biomedical Engineering Electives	6

		Free Electives	6
			Total 12

Minimum Total Program Credit-Hours: 151

Biomedical Engineering Elective Courses

Course		Title	Credit-Hours
BME	4120	Bio-fluid Mechanics	3
BME	4110	Biomechanics of Sport	3
BME	4130	Hospital Facilities and Maintenance	3
BME	4140	Medical Implants	3
BME	4220	Bioinformatics	3
BME	4240	Biomedical Data Acquisition and Analysis	3
BME	4250	Medical Imaging	3
BME	4040	Fundamental Concepts in Biomedical Engineering	3
BME	4050	Biostatistics	3
BME	4970	Biomedical Engineering Practice	3
BME	4980	Undergraduate Research in Biomedical Engineering	3
BME	4990	Special Topics in Biomedical Engineering	3

BIOMEDICAL ENGINEERING PROGRAM CURRICULUM SEQUENCE

(151 Credit-Hours)

First Year

First Quarter

Course		Title	Credit-Hours
BME	1010	Introduction to Biomedical Engineering	3
SPAN	1010	Linguistic Analysis of Literary Genres	3
ENGL	1010	The Study of the Essay as a Literary Genre	3
SCIE	1214	General Chemistry I	3
SCIE	1215	General Chemistry I Lab.	3
			Total 13

1st Year - Second Quarter

Course		Title	Credit-Hours
SPAN	2010	Hispanic Literature	3
ENGL	2030	Medical Terminology	3
SCIE	1130	Biology I	4
SCIE	1131	Biology I Lab.	0
SCIE	1220	General Chemistry II	4
SCIE	1221	General Chemistry II Lab.	0
			Total 14

1st Year - Third Quarter

Course		Title	Credit-Hours
MATH	1350	Calculus I	4
SCIE	1140	Biology I	4
SCIE	1141	Biology I Lab.	0
SPAN	2020	Business Spanish	3
ENGL	2020	Business English and Communication	3
			Total 14

Second Year

First Quarter

Course		Title	Credit-Hours

MATH	1360	Calculus II	4
SCIE	1230	Organic Chemistry I	4
SCIE	1231	Organic Chemistry I Lab.	0
		Social Science Elective	3
BME	2110	Computer Aided Drafting and Design for BME	3
		Total	**14**

2nd Year - Second Quarter

Course		Title	Credit-Hours
SCIE	1430	Physics I	4
SCIE	1431	Physics I Lab.	1
SCIE	1240	Organic Chemistry II	4
SCIE	1241	Organic Chemistry II Lab.	0
		Free Elective: (Pre-Med SPAN 2030 – Medical Terminology)	3
MATH 1370		Calculus III	4
		Total	**16**

2nd Year - Third Quarter

Course		Title	Credit-Hours
SCIE	1440	Physics II	4
SCIE	1441	Physics II Lab.	1
		Social Science Elective	3
		Free Elective (Pre-Med ENGL 2010 – Analysis of World Literature)	3
ENGI	2910	Engineering Mechanics: Statics and Dynamics Eng.	3
		Total	**14**

Third Year

First Quarter

Course		Title	Credit-Hours
BME	3010	Computer Programming for BME	3
EE	2000	Circuit Analysis I Eng.	3
ENGI	3440	Thermo-Fluid Mechanics	3
MATH	2350	Differential Equations	3
BME	3120	Biomaterials	3
		Total	**15**

3rd Year - Second Quarter

Course		Title	Credit-Hours
BME	3130	Fundamental of Biomechanics	3
BME	3220	Fundaments of Electronics	3
BME	3140	Transport Phenomena in Biological Systems	3
ENGI	2270	Engineering Probability and Statistics Eng.	3
		Total	**12**

3rd Year - Third Quarter

Course		Title	Credit-Hours
BME	3230	Biomedical Signal and Systems	3
BME	3150	Life Science Industry Manufacturing Processes	3
BME	3020	Physiological Modeling and Control Systems	3
BME	3131	Fundamentals of Biomechanics Lab.	1
		Total	**10**

Fourth Year

First Quarter

Course		Title	Credit-Hours
BME	4010	Rehabilitation Engineering and Industrial Automation	3
BME	4020	Regulations in the Life Sciences Industry	3
BME	3221	Biosystems Circuits and Electronics Lab.	1
BME	4230	Bioinstrumentation	3
		Total	**10**

4th Year - Second Quarter

Course		Title	Credit-Hours
BME	4992	Capstone Design I	3
BME	4011	Rehabilitation Engineering Lab.	1
BME	4210	Health Care Information Systems	3
BME	4030	Clinical Engineering	3
		Total	**10**

4th Year - Third Quarter

Course		Title	Credit-Hours
BME	4994	Capstone II	3
BME	XXXX	Technical Elective	3
BME	XXXX	Technical Elective	3
		Total	**9**

COURSE DESCRIPTIONS

BME 1010 – INTRODUCTION TO BIOMEDICAL ENGINEERING
Three credit-hours. Two two-hour lecture period per week. Prerequisites: None. Corequisite: None.

This course introduces the biomedical engineering field to freshman engineering students. The course focuses in teaching the main scope of the profession in the medical devices industry, healthcare industry, and research and development.

BME 2110 – COMPUTER AIDED AND DRAFTING AND DESIGN FOR BME
Three credit-hours. Two two-hour lecture periods per week. Prerequisite: None. Corequisite: None.

Introduction to Computer Aided and Drafting and Design (CADD), Engineering design process: drafting solid modeling dimensioning and tolerances. Graphics communication in biomedical engineering. 2D and 3D construction, visualization, sketching and standard lettering techniques using CADD. Orthographic Projections. Multi-view drawings for engineering design and production. Basic Dimensioning and tolerancing.

BME 3010 – COMPUTER PROGRAMMING FOR BME
Three credit-hours. Two two-hour lecture periods per week. Prerequisites: BME 2110, MATH 1350. Corequisite: None.

This course is designed to be the first experience in computer programming and is intended for the biomedical engineering students. The students will learn how to design, write and implement MATLAB scripts and subroutines to solve simple engineering problems. Topics include MATLAB environment selection and repetition structures, used defined functions, Data input and output, 2D Plotting and how to create simple Graphical User Interface (GUI). Students are required to complete a series of computer programming projects.

BME 3020 – PHYSIOLOGICAL MODELING AND CONTROL SYSTEMS
Three credit-hours. Two Two-hour lecture periods per week. Prerequisites: BME 3130, BME 3140, BME 3220. Corequisite: None.

A wide variety of biomedical processes behave as dynamic systems where the system states vary in time, often in response to external stimuli or interventions. The aims of this module are to introduce techniques and computer tools for modeling, predicting, analyzing and understanding dynamic behavior in biomedical systems.

BME 3120 – BIOMATERIALS
Three credit-hours. Two two-hour lecture periods per week. Prerequisites: SCIE 1240/1241. Corequisite: None.

This course introduces biomaterials of synthetic as well as natural origin that can be in contact with tissue, blood, and biological fluids with the intended use for prosthetic, diagnostic, therapeutic, and storage applications without adversely affecting the living organism or its components. The course emphasizes the selection and application of biomaterials to the design of bioengineering applications.

BME 3130 – FUNDAMENTALS OF BIOMECHANICS
Three credit-hours. Two two-hour lecture periods per week Prerequisites: BME 3120, ENGI 3440. Corequisite: None.

The mechanics of living tissue, e.g., arteries, skin, heart muscle, ligament, tendon, cartilage, and bone. Constitutive equations and some simple mechanical models. Mechanics of cells applications.

BME 3131 – FUNDAMENTALS OF BIOMECHANICS LAB.
One Credit-hour. One four-hour laboratory period per week. Prerequisite: BME 3130. Corequisite: None.

This laboratory course provides a hands-on introduction to the experimental analysis of the biomechanics of human motion. Students will learn to use computer software for data acquisition and analysis. Kinematic analysis will be performed using optoelectronic and electromagnetic motion sensors. Movement kinematics will be correlated to muscle activity data provided by electromyography (EMG). Analysis of movement kinetics will be performed using strain gauges and force sensors, including force plates for balance control experiments. The laboratory course emphasizes teamwork and communication skills through the submission of group written reports and oral presentations.

BME 3140 – TRANSPORT PHENOMENA IN BIOLOGICAL SYSTEMS
Three credit-hour. Two two-hour lecture periods per week. Prerequisites: SCIE 1140/1141, ENGI 3440, MATH 2350. Corequisite: None

This course introduces the integrated study of momentum, mass, and energy transfer, as well as thermodynamics and chemical reactions kinetics for the physiological and cellular processes characterization. This course is used for designing and operating medical devices and developing new therapies. Examples include kidney dialysis machines, heart-lung bypass machines, and membrane oxygenators.

BME 3150 – LIFE SCIENCE INDUSTRY MANUFACTURING PROCESSESS
Three credit-hours. Two two-hour lecture periods per week. Prerequisites: BME 3130, BME 3220. Corequisite: None.

This course covers typical manufacturing processes in the Pharmaceutical and Medical Devices Industries. Processes such as cleaning in place processes, automation, cnc programming, metal stampings, wiring, among others are covered.

BME 3220 – FUNDAMENTALS OF ELECTRONICS
Three credit-hour. Two two-hour lecture periods per week. Prerequisite: EE 2000. Corequisite: None.

Overview of semiconductors materials, introduction to solid-state devices such as diodes, Bipolar Junction Transistors (BJTs), Metal Oxide Semiconductor Field Effect Transistors (MOSFETs) and their characteristics, operation, circuits and typical applications. The operating principles and understanding of these nonlinear devices are studied to learn their use in electronic equipment. Characteristics of the Operational Amplifier and typical applications such as inverting and non-inverting amplifiers, comparators, summing and differentiating amplifiers, and active filters are studied. Classical applications of OPAMPs in biomedical circuits are discussed.

BME 3221 – BIOSYSTEMS CIRCUITS AND ELECTRONIC LAB.
One credit-hour. One four-hour laboratory period per week. Prerequisite: BME 3220. Corequisite: None.

This laboratory is designed to develop in the students the necessary skills to perform electrical measurements, as well as the necessary skills for the implementation and testing of typical electronic circuits. Experimental verification of the fundamental laws of electric circuits is required for all the experiments. Electrical measuring devices are used in the laboratory such as, the multimeter, the oscilloscope and the RLC meter, and any other equipment like power supplies, function generators and breadboards, which are used in the construction and testing of electric and electronic circuits. Practical electronics circuits that contain diodes, transistors

and operational amplifiers are studied and implemented. Use of computer programs to simulate the circuits to be implemented in the laboratory.

BME 3230 – BIOMEDICAL SIGNAL AND SYSTEMS
Three credit-hours. Two two-hour lecture periods per week. Prerequisites: BME 3220, ENGI 2270. Corequisite: None.

This course is centered on the theory of signal and systems with focus on the analysis of signals that originate in living systems. In particular, the course emphasizes signal examples related to the human body such as ECG, EEG, EMG, and others. Topics covered include Continuous-Time Signal and Systems, Discrete-Time Signal and Systems, Sampling, Fourier Analysis, z-Transform, Basic Filter Design and Spectral Analysis with applications to biomedical signals.

BME 4010 – REHABILITATION ENGINEERING AND INDUSTRIAL AUTOMATION
Three credit-hours. Two two-hour lecture periods per week. Prerequisites: BME 3230, BME 3131. Corequisite: None

This is the application of science and technology to design, research or improve devices and their ability to work and live as normally as possible. Assistive technology is applicable to musculoskeletal and sensory disabilities. Additionally, the course includes automation and digital control of industrial applications using electrical, electronic, hydraulic, and pneumatic control devices and systems.

BME 4011 – REHABILITATION ENGINEERING LAB.
One credit-hour. One four-hour laboratory period per week. Prerequisites: BME 4010, BME 3221. Corequisite: None.

Laboratory experiences in Rehabilitation Engineering and Industrial Automation using electrical, electronic, hydraulic, and pneumatic systems. The laboratory practices include the selection and implementation of sensors and actuators (i.e., mechanical, pneumatics and hydraulics), along with Programmable Logic Controllers and Microcontrollers. The laboratory emphasizes the application of these technologies in the rehabilitation and/or improvement of the quality of life for individuals with disabilities.

BME 4020 – REGULATIONS IN THE LIFE SCIENCE INDUSTRY
Three credit-hours. Two two-hour lecture periods per week. Prerequisites: BME 3150, ENGI 2270. Corequisite: None.

This course explores the content and interpretation of the FDA pharmaceutical and medical devices regulations. Using the regulations and warning letters the students analyze and apply their knowledge to identify trends and implications to compliance with the FDA regulations.

BME 4030 – CLINICAL ENGINEERING
Three credit-hours. Two two-hour lecture periods per week. Prerequisite: BME 4230. Corequisite: None.

This course focuses on the methodology for administering critical engineering services from facilitation of innovation and technology transfer to the performance of the technology assessment and operations support of clinics and hospitals. Roles of the clinical engineer include supervision of clinical engineering departments, design, repair, purchase, and evaluate new and existing medical equipment, biomedical computer support, input to clinical facilities, and documentation and implementation protocols.

BME 4210 – HEALTH CARE INFORMATION SYSTEMS
Three credit-hours. Two two-hours lecture periods per week. Prerequisite: BME 4020, BME 3230. Corequisite: None.

This course is intended to teach students how to use the information systems to program and maintain hospital information system (HIS), computer-based patient records (CBPR), imaging, communications, standards and other related areas.

BME 4230 – BIOINSTRUMENTATION
Three credit-hour. Two two-hour lecture periods per week. Prerequisite: BME 3230. Corequisite: None.

The course describes the principles, design, and applications of the most used medical instruments in hospitals. Due to the rapid change in the different model of instruments, the course focuses more on the fundamental principles of operation of those instruments that are common to all different models of these kinds of instruments. The course assumes the students are familiar with differential equations, strong knowledge of physics, and some knowledge in electric and electronic courses.

BME 4992 – CAPSTONE DESIGN I

Three credit-hours. Two two-hour lecture period per week. Prerequisites: BME 3020, BME 4010, BME 4020. Corequisite: None.

The team performs a systematic design process to solve a multidisciplinary biomedical engineering problem. Weekly written and oral reports required.

BME 4994 – CAPSTONE II
Three credit-hours. Two two-hour lecture periods per week. Corequisites: BME 4992, BME 4011, BME 4030, BME 4210. Corequisite: None.

Teams perform a systematic design process to solve a multidisciplinary biomedical engineering problem. Weekly written and oral reports are required.

ENGI 2910 – ENGINEERING MECHANICS: STATICS AND DYNAMICS
Three credit-hours. Two two-hour lecture periods per week. Prerequisite: MATH 1360, SCIE 1430. Corequisite: None.

Fundamental of statics and dynamics using vector methods in rigid body. The course emphasizes the application of Newton's laws, analysis of force system. Law of equilibrium for rigid body, kinematics and kinetics, angular kinetics and kinematics, work, energy and momentum of rigid bodies.

BME Technical Electives Courses

BME 4040 – BIOSTATISTICS
Three credit-hours. Two two-hour lecture periods per week. Prerequisite: BME 4020. Corequisite: None.

This course introduces the student to selected topics in biostatistics concepts. Descriptive statistics and graph to analyze variability in data; hypothesis testing to perform inference on population means and proportions using sample data; hypothesis testing to comparison means and proportions; correlation and simpler linear regression concepts will be essential on the analysis of integrated systems, processes, and components.

BME 4050 – FUNDAMENTAL CONCEPTS IN BIOMEDICAL ENGINEERING
Three credit-hour. Two two-hour lecture periods per week. Prerequisites: SCIE 1240, SCIE 1440. Corequisite: None.

This course focuses on the study of miscellaneous important concepts and principles emphatically necessary for pre-medical students and highly recommended for biomedical engineering students. It covers essential topics in applied biology and organic and inorganic chemistry. This course emphasizes the study of compounds of biological importance such as proteins, nucleic acids, carbohydrates, and lipids. Special attention is placed on structure and function of these biopolymers and their constituents as well as the principles of bioenergetics and fuel molecules metabolism and the transmission of genetic information; it also covers enzyme catalysis, including mechanistic considerations, kinetic, models of enzyme-substrate interaction, and regulation.

BME 4110 – BIOMECHANICS OF SPORTS
Three credit-hours. Two two-hour lecture periods per week. Prerequisite: BME 3131. Corequisite: None.

Anatomical and mechanical bases of physical activity with emphasis on the analysis of sport and exercise skills. This course focuses upon the development of techniques of human movement analysis from structural and functional points of view and incorporates principles of mechanics as they apply to the analysis of human motion. Examples will be drawn from joint movements and sport skills to illustrate these types of analyses. Applications to baseball swing/pitching, boxing punch, soccer kicking among other will be analyzed.

BME 4120 – BIOFLUID MECHANICS
Three credit-hours. Two two-hour lecture periods per week. Prerequisite: BME 3130. Corequisite: None.

This course is designed to study fluid mechanics applied in the biological flows. Students will gain an understanding of the basic fluid governing equations in addition to blood rheology and disease. Mathematical models will be used to simulate flows in the cardiovascular, circulatory, and respiratory system. This class includes drug delivery in the human through different systems.

BME 4130 – HOSPITAL FACILITIES AND MAINTENANCE
Three credit-hour. Two two-hour lecture periods per week. Prerequisite: BME 4030. Corequisite: None.

This course presents an introduction to the principles of design, and maintain medical gas, energy and power supply systems used in hospitals such as water, gas, vacuum and steam systems, air conditioning units, heat exchangers and electric generators.

BME 4140 – MEDICAL IMPLANT
Three credit-hours. Two two-hour lecture periods per week. Prerequisite: BME 4020. Corequisite: None.

This course introduces the most relevant and important concepts of medical implants. Therapeutic instrumentation, such as pacemakers, defibrillation, and prosthetic devices, will be reviewed considering the area of placement, the duration of the implant, the safety and efficacy. Each medical implant studied includes an exposition pf appropriate physiology, mathematical modeling or biocompatibility issues, as well as clinical need.

BME 4220 – BIOINFORMATICS
Three credit-hour. Two two-hour lecture periods per week. Prerequisite: BME 4210. Corequisite: None.

The course introduces the student to the bioinformatics field that consists of leveraging computer resources to analyze complex and vast amount of biological data. The course brings together the field of computer science, biology, and mathematics to analyze the DNA, RNA, Protein structure, and metabolic pathways. This information can then be used in applied fields such as drug discovery among other.

BME 4240 – BIOMEDICAL DATA ACQUISITION AND ANALYSIS
Three credit-hour. Two two-hour lecture periods per week. Corequisite: 4011. Corequisite: None.

The course covers the topics such as basic sensors in biomedical engineering, biological signal measurement and conditioning, data acquisition and data analysis. The student will learn the techniques of collecting biological signals using basic sensors. The student must need a previous course that covers digital signal processing and filtering analog signals in other to using simulation software as Mathlab and Labview in their class room projects.

BME 4250 – MEDICAL IMAGING
Three credit-hours. Two two-hour lecture periods per week. Prerequisites: BME 3230, BME 3131. Corequisite: None.

The course gives an introduction to two-dimensional signal and systems with a focus on the enhancement of biomedical images acquired from human subjects. In particular, the course emphasizes image acquisition techniques and enhancement of biomedical images extracted through Ultrasound imaging, X-Ray imaging, Gamma-Ray imaging, CT-Scans, MRI, and other techniques. Topics covered include, Image Enhancement in the Spatial Domain and in the Frequency Domain.

BME 4970 – BIOMEDICAL ENGINEERING PRACTICE
Three credit-hours. Two two-hour lecture periods per week. Prerequisites: BME 3230, BME 3131, Director/Coordinator Consent. Corequisite: None.

Perform a systematic design process to solve a biomedical engineering problem. Weekly written and oral reports are required.

BME 4980 – UNDERGRADUATE RESEARCH IN BIOMEDICAL ENGINEERING
Three credit hours. Two-two hours lecture periods per week. Prerequisites: BME 3230, BME 3131, Director/Coordinator Consent. Corequisite: None.

Perform a systematic design process to solve a biomedical engineering problem. Weekly written and oral reports are required.

BME 4990 – SPECIAL TOPICS IN BIOMEDICAL ENGINEERING
Three credit-hours. Two two-hour lecture periods per week. Prerequisites: BME 3230, BME 3131, Director/Coordinator Consent. Corequisite: None.
Arrange by individual faculty with special expertise; these courses survey fundamentals in areas that are not covered by the regular Biomedical engineering course offerings. Exact course descriptions are disseminated by the Biomedical Engineering Office well in advance of the offering. Courses may be in Tissue Engineering, Nanotechnology in Biomedical Engineering, Multiphysics Simulation of Biomedical Systems, and Continuous Improvement in Healthcare.

DEPARTMENTAL FACULTY

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