DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

3- Biomedical Engineering Program

Mission

The educational mission of Biomedical Engineering (BME) Program is to deliver high quality undergraduate education which combines balanced theoretical and practical topics in Biological, Medical and Electrical systems. Graduates of the program will have a mastery of fundamental knowledge in a variety of Biomedical Engineering fields, management, and entrepreneurial skills. Graduates will be qualified to pursue successful careers in their profession or graduate studies in different areas.

Objectives

The educational objectives of the program are determined to support career advancement of the graduates as they pursue their career goals. The graduates will:

1. Design biomedical systems in tune with communityneeds and environmental concerns
2. Develop and integrate new technologies as they emerge
3. Engage in a technical/managerial role in diverse teams
4. Pursue entrepreneurial initiatives and launch startup companies

Learning Outcomes

UPON COMPLETION OF THE PROGRAM GRADUATES SHALL GAIN:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Degree Requirements

The undergraduate curriculum for the degree of Bachelor of Engineering in Biomedical Engineering consists of 150 credit-hours of course work + IC003, where the standard duration of study is 8 semesters.

Career opportunities

Biomedical engineers are responsible for the creation of artificial organs, automated patient monitoring, blood chemistry sensors, advanced therapeutic and surgical devices, application of expert systems and artificial intelligence to clinical decision making, design of optimal clinical laboratories, medical imaging systems, computer modeling of physiological systems, biomaterials design, and biomechanics for injury and wound healing, among many others.

Program Overview

The **Student's Study Plan** is given to every BME student upon his/her enrollment. The BME curriculum consists of the following components:

I. Common Requirements	Credits
General Education Requirements	20
Basic Sciences and Mathematics	26
General Engineering topics	9
II. BME Program-Specific Requirements	**Credits**
A. Engineering topics from outside the major	2
B. Basic Electrical, Computer and Communications Engineering	35
C. BME Core	41
D. BME Technical Electives	12
E. Final Year Project	4
F. Internship	1

I. Common Requirements

The list of the Common Requirement courses and their descriptions are presented in the introductory pages of the Faculty of Engineering section in this catalog. In particular, the BIME curriculum includes 9 credits offered as general engineering topics. These courses are listed in the table below.

Code	Name	Crs.
MCHE 213	Dynamics	3
COMP 208	Programming I	3
INME 221	Engineering Economy	3

II. BME Program-Specific Requirements

A. Engineering Topics From Outside The Major

This part of the biomedical engineering curriculum includes 2 credits offered by other engineering programs. The course is listed in the table below.

Course	Title	Credits	Pre-/Co- requisites
ENGR 002	Introduction to Engineering	2	

Descriptions of this course is given below:

ENGR 002 INTODUCTION TO ENGINEERING (2Crs.: 2Lec,0Lab): Introducing the student to the engineering profession in general and the learning objectives that new students should attain, as aligned with the ABET requirements. Covering the basics of the engineering profession and engineering ethics. Introduction to the different engineering majors and to the learning objectives as specified by ABET. Insight into different engineering courses that are not technical in nature (e.g., engineering economy)
Engineering design tasks that allow the student to start thinking as engineers: problem definition, specification of constraints, investigation of different solution alternatives, implementation of best solution, writing technical reports. Fundamental tools and numerical software used in engineering. The tools and software covered could be generic or specific to a major.

B. Basic Electrical, Computer and Communication Engineering

This part of the BME curriculum includes 35 credits courses offered by the Electrical and Computer Engineering Department. These courses are listed in the table below.

Course	Title	Credits	Pre-/Co- requisites
POWE 212	Electric Circuits I	3	

POWE 271	Electromagnetic Fundamentals	3	Pre: PHYS 281
POWE 342	Control Systems I	3	Pre: MATH 283, COME 214
COME 214	Electric Circuits II	3	Pre: POWE 212
COME 212L	Electric Circuits Lab	1	Pre: POWE 212, Co: COME 214
COME 221	Electronic Circuits I	3	Pre: POWE 212
COME 222	Electronic Circuits II	3	Pre: COME 221
COME 222L	Electronic Circuits Lab	1	Pre: COME 221, CO: COME 222
COME 381	Signals and Systems	3	
COME 384	Digital Signal Processing	3	Pre: COME 381, MATH 284
COMP 225	Digital Systems I	3	
COMP 226	Digital Systems II	3	Pre: COMP 225
COMP 335	Microprocessors for Biomedical Engineering	3	Pre: COMP 226

Descriptions of this group of courses are given below:

POWE 212 ELECTRIC CIRCUITS I (3Crs.:3Lec,0Lab): Circuit variables: voltage, current, power, and energy. Circuit elements: resistors, inductors, capacitors, voltage sources, and current sources. Circuit reduction techniques: series and parallel resistors and delta-to-wye transformation. Ohm's law. Kirchhoff's laws. DC and AC circuit analysis techniques: node-voltage and mesh-current methods, source transformations, Thévenin and Norton equivalent circuits, and maximum power transfer. Self and mutual inductances. AC steady-state power calculations. Balanced three-phase circuits.

POWE 271 ELECTROMAGNETIC FUNDAMENTALS (3 Crs.: 3Lec,0Lab): Three-dimensional orthogonal coordinate systems: Cartesian, Cylindrical and Spherical. Vector Analysis: Gradient, Divergence and Curl of fields, Divergence theorem, Stokes's theorem. Fundamental Postulates of Electrostatics in free space, Coulomb's Law in space, Gauss's Law in space. Material Media: Conductors and Dielectrics, Polarization, Electric Flux Density. Boundary Conditions. Capacitors and Electrostatic Energy. Poisson's Equation, Laplace's Equation, Method of Images, Boundary Value Problems, Steady Electric Currents: conduction and convection currents, equation of continuity, boundary conditions for current density. Resistance and Power calculations. Fundamental Postulates of Magnetostatics in free space, Biot-Savart law in space, Ampere's Law in space. Magnetic materials: Magnetization, Inductance and Magnetostatic Energy. Magnetic circuit analysis. Introduction to Magnetic Forces and Torques. Time varying fields: Faraday's Law for Electromagnetic Induction (stationary circuit in a time-varying magnetic field, Transformers, moving circuit in steady and time-varying magnetic fields), Maxwell's Equations, Electromagnetic boundary conditions. ***Pre-requisite: PHYS 281***

POWE 342 CONTROL SYSTEMS I (3 Crs.: 3 Lec): History and role of control systems. Transfer function models. Block diagram representation and reduction. Transient and steady-state response analyses. Root-locus analysis and design. Frequency-response analysis and design. Simulation using MATLAB. ***Pre-requisite: MATH 283, COME 214.***

COME 214 ELECTRIC CIRCUITS II (3Crs.:3Lec,0Lab): Transient analysis, Laplace transform and its application to circuit analysis, two-port networks, frequency selective passive and active circuits. ***Pre-requisite: POWE 212***

COME 212L ELECTRIC CIRCUITS LAB (1Cr.:0Lec,2Lab): The content of this lab is directly related to the courses POWE 212, COME 214. ***Co-requisite.: COME 214.***

COME 221 ELECTRONIC CIRCUITS I (3Crs.:3Lec,0Lab): Introduction to semiconductor physics, junction diodes: construction, I-V characteristics, circuit models, applications, special purpose diodes: Zener diodes. Bipolar junction transistors (BJT) and field effect transistors (FET): types, physical structures, basic configurations, characteristic curves, circuit models, biasing circuits, small-signal amplifiers. ***Pre-requisite.: POWE 212.***

COME 222 ELECTRONIC CIRCUITS II (3Crs.:3Lec,0Lab): BJT and FET amplifiers: Types, circuit models, frequency response, differential and multistage amplifiers, large signal analysis and power amplifiers, operational amplifiers: Characteristics, applications, imperfections, feedback amplifiers, sinusoidal oscillators and multi-vibrators. ***Pre-requisite.: COME 221.***

COME 222L ELECTRONIC CIRCUITS LAB (1Cr.:0Lec,2Lab): The content of this lab is directly related to the courses COME 221, COME 222.***Co-requisite: COME 222.***

COME 381 SIGNALS AND SYSTEMS (3Crs.:3Lec,0Lab): Signals and systems properties and classifications. Continuous Linear Time-Invariant systems. Analytical and graphical convolution and correlation. Fourier series and Fourier Transform. Hilbert transform, pre-envelope, complex envelope. Laplace transform. Frequency spectra, energy and power spectra. Frequency response and transfer function, impulse response and step response. Analog Filter design. Butterworth and Chebyshev filters.

COME 384 DIGITAL SIGNAL PROCESSING (3Crs.:2Lec,2Lab) Sampling, Quantization and SQNR. Signal Reconstruction and anti-aliasing filter. Discrete time signals. Difference equations and impulse responses. BIBO stability. Digital convolution. Discrete Fourier Transform and Fast Fourier Transform. Z-transform. Digital filter frequency response and transfer function. Z-plane stability. Realization of digital filters. Methods of FIR and IIR filter designs. Digital Butterworth and Chebyshev filter designs***. Pre-requisite: COME 381*** and ***MATH 284.***

COMP 225 DIGITAL SYSTEMS I (3Crs.:2Lec,2Lab) Number systems and coding, Binary systems. Conversion from decimal to other bases. BCD numbers. Boolean algebra. Logic gates. Function minimization, Tabular method, Karnaugh mapping. Arithmetic functions and circuit design (HA, FA, and ALU). Combinational functions and circuit design (decoder, encoder, multiplexer and de-multiplexer). Sequential circuits components (Latches, RS-FF, D-FF, JK-FF, T-FF). Introduction to VHDL. Several laboratory experiments will be based on simple logic gates.

COMP 226 DIGITAL SYSTEMS II (3Crs.: 2Lec, 2Lab): Latches and flip-flops. Synchronous and asynchronous sequential systems. Design of sequential circuits using state diagrams. Registers and Counters. Programmable logic devices (PAL and PLA). Control and Datapath units. Cache memory concept. Serial data transfer for multiple registers. Types of RAM and ROM. Cache memory concept. ALU functions and circuits. Binary multipliers. BCD functions and circuits. Several laboratory experiments and projects will be based on course topics. ***Pre-req.: COMP 225.***

COMP 335 MICROPROCESSORS FOR BIOMEDICAL ENGINEERING (3Crs.: 2Lec, 2Lab): The course focuses on the principle of microprocessors and microcontrollers and their applications in Biomedical Engineering. Introduction to hardware system: CPU, Memory, Input/Output Interfacing, and System Bus. Instruction sets; assembly and machine languages. Fetch Cycle, Execution cycle, Instruction cycle. Detailed study of a particular Microprocessor or Microcontroller architecture: Instruction set; assembly language programming, Programming techniques, Loops, Delays, parallel and serial interfaces, interrupt control systems; Timers. ***Pre- requisite: COMP 226***.

C. Biomedical Engineering Program Core

The BME program core courses are listed in the table below.

Course	Title	Credits	Pre-/Co-requisites
HESC 201	Human Anatomy & Physiology	3	
HESC 202	Health Care Profession & Bio Ethics	1	
BIOL 231	Biology I	3	
PHYS 352	Biophysics	3	
BIOL 334	Cell and Molecular Biology	3	Pre: BIOL 231
BIME 310	Biomedical Instrumentation I	3	
BIME 336	Machine Learning for Medical Applications	3	
BIME 411	Biomedical Instrumentation II	3	Pre: BIME 310
BIME 413	Biomedical Image Processing	3	Pre: COME 381
BIME 441	Biomedical Sensors	3	Pre: COME 222
BIME 411L	Biomedical Instrumentation Lab	1	Co: BIME 411
BIME 421	Biomedical Imaging I	3	Pre: BIME 336
BIME 422	Biomedical Imaging II	3	Pre: BIME 421
BIME 422L	Biomedical Imaging Lab	1	Co: BIME 422
BIME 432	Biological Materials	3	Pre: BIOL 231
BIME 500	Research Methodology	2	Pre: ENG300

Description of Core Courses

HESC 201 HUMAN ANATOMY AND PHYSIOLOGY (3Cr:2Lec,2Lab,0Tut): This course studies the structure (brief anatomy) and function (detailed physiology) of the following body systems: muscular, nervous, endocrine, blood, lymphatic, cardiovascular, respiratory, digestive, urinary, and reproductive.

HESC 202 HEALTHCARE PROFESSION AND BIOETHICS (1Cr:1Lec,0Lab,0Tut): course centers around understanding the significance of healthcare ethics and bioethics. It explores a range of topics at the intersection of religion, ethics and law, including assisted reproductive technologies, cloning and transplantation. It also emphasis on the ethics of professional conduct, such as privacy and confidentiality and other workplace related ethical issues, the importance of the work permit for health professions and on the ethics of research on human subjects.

BIOL 231 BIOLOGY I (3Crs.:3Lec): This course introduces the students to fundamental concepts in biology. Topics to be covered include the cellular and chemical basis of life, organization of life, energy transfer through living organisms, evolution, diversity of life with emphasis on the animal and plant kingdoms and their interaction with the environment.

PHYS 352 BIOPHYSICS (3Crs.:3Lec): The aim of the course is to study the cellular and molecular biophysics and cover, in depth, the molecular phenomena related to biologic processes. The course addresses organ systems and the principles of physics in the processes of locomotion, Static forces, mechanical characterization of materials, physics of cardiovascular system, energy supplied by the heart and cardiac output, fluid mechanics including blood and fluid flow, respiration, audition and vision, including different types of waves. Moreover, the aim is to study bioelectric phenomena such as resting and action potentials with their physical tools, fundamentals of bioelectricity, basic circuit theory for modeling the nervous system and action potential generation and propagation, and continue to electrical stimulation and field potentials.

BIOL 334 CELL AND MOLECULAR BIOLOGY (3Cr.:3Lec): This course provides an introduction to cell biology emphasizing on cell division, cell cycle, structure and function of cellular organelles and the functional interaction of the cells with their microenvironment, an overview on DNA replication, transcription and translation, regulation of gene expression in prokaryotes and eukaryotes and protein synthesis. This course also covers molecular biology techniques including isolation and purification of nucleic acids, enzymes used in molecular biology such as restriction endonucleases and ligases, genomic library, PCR, Southern, northern and western blotting, sequencing, and cloning. ***Pre-requisite: BIOL 231***

BIME 336 MACHINE LEARNING FOR MEDICAL APPLICATIONS (3Crs.:3Lec): Basics of machine learning, supervised and unsupervised learning, machine learning techniques including neural networks, support vector machines, regression models, Bayesian models, and classification trees. introduction to deep learning. Examples of artificial intelligence for computational medicine (oncology, pathology, physiology, anatomy of diseases) and discussion of the interpretability and ethics of machine learning for medical applications.

BIME 413 BIOMEDICAL IMAGE PROCESSING (3Crs.:3Lec): Basics of imaging including the differences between pixels and voxels, spatial resolution, orientation, and data type. Medical imaging file formats (DICOM, Nifti, Minc). Basics of image processing for biomedical applications: statistical characterization, filtering, enhancement, registration, edge detection, spectral representation, transformations. Applications to medical images including x-rays, computed tomography (CT), MRI and functional MRI, SPECT and PET. ***Pre-requisite: COME 381***

BIME 441 BIOMEDICAL SENSORS (3Crs.:2Lec,2Lab): Introduction to biomedical sensors. Sensors are used for measuring: pressure, temperature, blood flow, motion, PH… Acquisition of biomedical signals, EEG,ECG, EMG…Signal conditioning and noise. ***Pre-requisite.: COME 222***

BIME 310 BIOMEDICAL INSTRUMENTATION I (3Crs.:3Lec): Basic concepts of medical instrumentation, amplifiers and signal processing, biopotential electrodes, biopotential amplifiers, blood pressure and sound phono cardiography, cardiac catheterization, measurement of flow and volume of blood indicator-dilution methods, electromagnetic and ultrasonic flow meters, plethysmograph, measurements of the respiratory system, chemical biosensors.

BIME 411 BIOMEDICAL INSTRUMENTATION II (3Crs.:3Lec): Clinical laboratory instrumentation: spectrophotometry, photometers, fluorometry, automated chemical analyzers, chromatography, electrophoresis, and hematology. ***Pre-requisite.: BIME 310***

BIME 411L BIOMEDICAL INSTRUMENTATION LAB (1Cr: 3 Lab): The content of this lab is directly related to the courses BIME 310, BIME 411. ***Co-requisite: BIME 411.***

BIME 421 BIOMEDICAL IMAGING I (3Crs.:3Lec): This course introduces imaging tools like X-ray, computed tomography (CT), magnetic resonance imaging (MRI), nuclear medicine (PET and SPECT), and ultrasound. Introduction to medical image processing and analysis. ***Pre-requisite: BIME 336***.

BIME 422 BIOMEDICAL IMAGING II (3Crs.:3Lec): This course covers magnetic resonance imaging schematics for CT, MRI pulse sequences, MRI instrumentation and equipment, MRI safety. X-ray image geometry, magnification radiography, X-ray site protection. Fluoroscopy, catheterization and endoscopy. ***Pre-requisite: BIME 421.***

BIME 422L BIOMEDICAL IMAGING LAB (1Cr, 3Lab): The content of this lab is directly related to the courses BIME 421, BIME 422***. Co-requisite: BIME 422***

BIME 432 BIOLOGIOCAL MATERIALS (3Crs.:2Lec, 2Lab): Properties of materials used in medicine, biodegradation and toxic kinetic, sterilization processes, cytotoxicity, interactions with blood, genotoxicity, carcinogenicity. Regulatory aspects of biomaterials. ***Pre-requisite.: BIOL 231***.

D. Biomedical Engineering Program Technical Electives

The BME curriculum includes 12-credit hour courses as technical electives. The courses are chosen from the courses listed in the table below, with their descriptions given thereafter. (At least 6 credits has to be gained from BIME courses).

Course	Title	Credits	Pre-/Co-requisites
BIME 511	Cell and Tissue Engineering	3	Pre: BIOL 231
BIME 514	Medical Equipment	3	Pre: BIME 310
BIME 541	Telemedicine	3	Pre: BIOL 231
BIME 532	Introduction to Neuroscience for Engineers	3	Pre: BIOL 231
BIOL 451	Bioinformatics	3	Pre: BIOL 334
ENGR 003	Engineering Project Management	3	Pre: ENGL 300
BIME 520	Artificial Organs	3	Pre: BIME441, HESC201
COMP 424	Artificial Intelligence and Robotics for Engineers	3	Pre: COMP 208

Description of Technical Elective Courses

BIME 511 CELL AND TISSUE ENGINEERING (3Crs.:3Lec,0Lab): Applying engineering principles, combined with molecular cell biology, to develop a fundamental understanding of property-function relationships in cells and tissues. Exploiting this understanding to manipulate cell and tissue properties to alter, restore, maintain, or improve cell and tissue functions; and to design bio-artificial tissue substitutes***. Pre-requisite: BIOL 231.***

BIME 514 MEDICAL EQUIPMENT (3Crs.:3Lec,0Lab): Inspection and preventive maintenance program, hospital and home patient equipment, lab equipment, ventilators, hemodialysis machine, anesthesia machine, diagnosis imaging and radiology machines. ***Pre-requisite: BIME 310.***

BIME 541 TELEMEDICINE (3Crs.:3Lec,0Lab): Describes and analyses the role of information and communications technologies in enabling remote patient care, health professional collaboration at a distance, and in supporting patient-self management. This is considered with reference to technological, clinical, sociological and policy perspectives. ***Pre-requisite: BIOL 231.***

BIME 532 INTRODUCTION TO NEUROSCIENCE FOR ENGINEERS (3Crs.:3Lec,0Lab): Introduction to the nervous system, with emphasis on the structure and function of the human brain. Functions of nerve cells, sensory systems, control of movement, learning and memory, and diseases of the brain. Review of neuro engineering methods and technologies that enable the study of and therapeutic solutions for diseases or damage of the nervous system. ***Pre-requisite: BIOL 231.***

BIOL 451 BIOINFORMATICS (3Crs.:2Lec,2Lab): This course covers basic principles of bioinformatics. Topics include biological databases, sequence homology searching, sequence alignment, genome browsers, motif finding, protein structure analysis and modeling and gene expression analysis. This course also includes practical application of bioinformatics tools. ***Pre-requisite: BIOL 334.***

ENGR 003 ENGINEERING PROJECT MANAGEMENT (3Crs.: 3Lec, 0Lab) The course covers the characteristics, techniques and challenges associated with initiating, planning, executing, controlling and closure of projects. Project management skills are discussed as they apply to projects, with special focus on leadership, teaming, and coordinating individual and group efforts. MS Project is introduced to provide hands-on practical skills with building a project plan, scheduling tasks, assigning resources, managing dependencies, monitoring progress and costs, keeping projects on track, and communicating project data through Gantt charts. ***Pre: ENGL 300.***

INME 482 ENGINEERING PROJECT MANAGEMENT (3 Crs.: 3 Lec): The course covers the characteristics, techniques and challenges associated with initiating, planning, executing, controlling and closure of projects. Project management skills are discussed as they apply to projects, with special focus on leadership, teaming, and coordinating individual and group efforts. MS Project is introduced to provide hands-on practical skills with building a project plan, scheduling tasks, assigning resources, managing dependencies, monitoring progress and costs, keeping projects on track, and communicating project data through Gantt charts. ***Pre-requisite: ENGL 300.***

BIME 520 Artificial Organs (3 Crs.: 3 Lec, 0Lab) The course main goal is to provide technologies that will maintain, preserve, safeguard, improve, or restore the function of diseased organs. The replacement of failing human organs with artificial devices and systems in order to improve the healthcare services. ***Pre-requisite: BIME 441, HESC 201.***

COMP 424 Artificial Intelligence and Robotics for Engineers (3 Crs.: 3 Lec, 0Lab): Introduction to artificial intelligence and machine learning. Introduction to robotics. Programming in Python: data type, expressions, functions, loops and control. Data plotting and analysis. Smart agent models. Supervised and unsupervised learning. Knowledge representation and reasoning. ***Pre-requisite: COMP 208.***

E. Final Year Project

BIME 500 RESEARCH METHODOLOGY (2Crs.:2Lec,0Lab): Why to Conduct Scientific Research, stepping in: Research Methodology. Formulating a research problem, conceptualizing a research design, constructing an instrument for data collection. Selecting samples, writing a research proposal, collecting data, processing & displaying data, writing a research report. Conducting Scientific Research at the faculty of Engineering. ***Pre-requisite: ENG300.***

BIME 501 FINAL YEAR PROJECT I (1Cr) / BIME 502 FINAL YEAR PROJECT II (3Crs) After completing 120 credits of course work, the student becomes eligible to sign up for the Final Year Project (FYP) that extends over two semesters; beginning in Fall-semester and ending in the following Spring-semester. The FYP experience requires students to work in teams to complete a specific project, submit a technical report, and give a presentation on a significant, relevant, and comprehensive engineering problem. The FYP is intended to stimulate student creativity and critical thinking, and build skills in formulating, designing, developing, building, communicating, and managing engineering projects. The project aims to provide students with a transitional experience from the academic world to the professional world. ***BIME500 Pre/Co-requisite and INME221 *Pre-requisite for BIME501. BIME 501 *Pre-requisite for BIME 502.***

Refer to the Final Year Project Policy for more details.

Starting from Spring 2023-2024.

F. Internship

BIME 499 INTERNSHIP (1Cr) This is a professional training which should not be less than four weeks. The training is followed by a presentation session where the students are supposed to present what they have learned. *Refer to the department policy for further details*.

Study Plan

Bachelor of Engineering in Biomedical Engineering (150 Credits)

First Semester (17 Credits)		**Crs.**	**Pre/Co-requisites**
MATH 281	Linear Algebra	3	Pre: MATH112
MATH 282	Calculus	3	Pre: MATH111
MCHE 213	Dynamics	3	
PHYS 281	Electricity and Magnetism	3	Pre: PHYS120
ENGR 002	Introduction to Engineering	2	
BLAW 001	Human Rights	1	
ARAB 001	Arabic Language	2	

Second Semester (17 Credits)		**Crs.**	**Pre/Co-requisites**
COMP 225	Digital Systems I	3	
MATH 283	Differential Equations	3	Pre: MATH 281, MATH 282
PHYS 282	Material Properties and Heat	3	
COMP 208	Programming I	3	
POWE 212	Electric Circuits I	3	
ENGL001	General English	2	

Summer I (9 Credits)		**Crs.**	**Pre/Co-requisites**
CHEM 241	Principles of Chemistry	3	Pre: CHEM 110
ENGL 211	Advanced Writing	2	Pre: ENGL 001
	Elective(General)	4	

Third Semester (16 Credits)		**Crs.**	**Pre/Co-requisites**
BIOL 231	Biology I	3	
COME 221	Electronic Circuits I	3	Pre: POWE 212
COME 214	Electric Circuits II	3	Pre: POWE 212
COME 212L	Electric Circuits LAB	1	Co: COME 214
COMP 226	Digital Systems II	3	Pre: COMP 225
POWE 271	Electromagnetic Fundamentals	3	Pre: PHYS 281

Fourth Semester (15 Credits)		**Crs.**	**Pre/Co-requisites**
MATH 381	Probability and Statistics	3	Pre: MATH 282
MATH 284	Numerical Analysis	3	Pre: MATH 283
COME 222	Electronic Circuits II	3	Pre: COME 221
COME 222L	Electronic Circuits Lab	1	Co: COME 222
INME 221	Engineering Economy	3	
ENGL 300	Speech Communications	2	Pre: ENGL 211

Summer II (9 Credits)		**Crs.**	**Pre/Co-requisites**
CHEM 405	Solid State Chemistry	2	
ENGR001	Engineering Ethics	1	
MGMT 002	Entrepreneurship	2	
	Elective (General)	4	

Fifth Semester (18 Credits)		**Crs.**	**Pre/Co-requisites**
COME 381	Signals and Systems	3	
HESC 201	Human Anatomy & Physiology	3	
BIOL 334	Cell and Molecular Biology	3	Pre: BIOL 231
BIME 441	Biomedical Sensors	3	Pre: COME 222
COMP 335	Microprocessors for Biomedical Engineering	3	Pre: COMP 226
	Technical Elective	3	

Sixth Semester (16 Credits)		**Crs.**	**Pre/Co-requisites**
HESC 202	Health Care Profession & Bio Ethics	1	
PHYS 352	Biophysics	3	
POWE 342	Control Systems I	3	Pre: MATH 283, COME 214
BIME 310	Biomedical Instrumentation I	3	
BIME 336	Machine Learning for Medical Applications	3	
COME 384	Digital Signal Processing	3	Pre: COME 381

Summer III (1 Credit)		**Crs.**	**Pre/Co-requisites**
BIME 499	Internship (Approved Experience / Independent Study)	1	

Seventh Semester (16 Credits)		**Crs.**	**Pre/Co-requisites**
BIME 413	Biomedical Image Processing	3	Pre: COME 381
BIME 411	Biomedical Instrumentation II	3	Pre: BIME 310
BIME 411L	Biomedical Instrumentation Lab	1	Co: BIME 411
BIME 421	Biomedical Imaging I	3	Pre: BIME 336
BIME 500	Research Methodology	2	Pre: ENG300
BIME 501	Final Year Project I	1	Pre./Co: BIME 500, *Pre: INME221
	Technical Elective	3	

Eighth Semester (16 Credits)		**Crs.**	**Pre/Co-requisites**
BIME 422	Biomedical Imaging II	3	Pre: BIME 421
BIME 422L	Biomedical Imaging Lab	1	Co: BIME 422
BIME432	Biological Materials	3	Pre: BIOL 231
BIME 502	Final Year Project II	3	Pre: BIME 501
	Technical Elective	3	
	Technical Elective	3	

***Starting from Spring 2023-2024.**