COURSE CATALOG

Course ID	Course Name	(Lec-Lab-Credit Hrs)
2171410	**Biology**	**(3-2-4)**
Cell biology, Cell membrane, Mediated transport system, Bulk transport, Cytoplasm and Nuclear cell biology, Cell cycle and cell division, Meiosis and gameto-genesis, the chemistry of life, Photosynthesis, genetics and an introduction to human anatomy. *Prerequisite: None*		
2181180	**Biochemistry**	**(3-2-3)**
Comprehensive survey of the major topics in biochemistry, with the objective of developing the tools necessary to understand biological processes in chemical terms. Structural organization and function of the major components of living cells: proteins, carbohydrates, lipids, nucleic acids, and vitamins. It explores how the structure of these molecules relates to their function. Metabolism and energy production. The metabolism of carbohydrates, proteins, lipids, and nucleic acids. Biosynthesis of small molecular weight compounds and macromolecules. *Prerequisite: 2171410*		
2182420	**Human Anatomy**	**(3-2-3)**
Introduction to the human body -basic anatomical terminology, anatomical position, regional names, directional terms, body cavities, abdominopelvic quadrants. Cell membrane and related components, cytoplasm and all intracellular organelles. The Skeletal System The Muscular System, Skeletal muscle, Nervous System, Cardiovascular system, Smooth Muscles: respiratory system, digestive system, urinary system, endocrine system, lymphatic system, reproductive system. *Prerequisite: 2181410*		
2182450	**Human Physiology**	**(3-2-3)**
Cell Physiology, nervous system physiology, muscles physiology, cardiovascular system components and their functions. Respiratory system, Digestive system, Urinary system, Endocrine, Lymphatic systems and Reproductive system and their functions. *Prerequisite: 2182420*		
2173210	**Report writing and Presentation**	**(3-0-3)**
Introduction, abstraction, audience and purpose, report writing and audience, ethical considerations in report writing, technical definitions, description of a mechanism, description of process, technical proposals, progress reports, feasibility and recommendation reports, laboratory and project reports, instructions and manuals, research reports, questionnaires for survey, abstract and summaries, grammar, style and punctuation, documentation, visuals, presentations, business communications, resume and cover letters.		

Prerequisite: 2181516

2183460	**Electrophysiology**	**(3-2-3)**

Volume conductor theory: Potentials, fields and currents, mono-pole and dipole fields, volume conductor properties of passive tissues. Basic electro-physiology: membranes, bio-electric loops, membrane polarization and depolarization, resting, action potential generation and propagation. Circuit models of cell membrane: parallel conductor model of the cell membrane, Hodgkin-Huxley resistor battery model and Goldman-Hodgkin-Katz constant field formulation. Simplified models for nerve cells, skeletal muscle cells, endocrine cells, cardiac cells, smooth muscles simplified model. Bio-electrodes: Ag/AgCl electrode, body surface electrodes, internals electrodes, microelectrodes. Biosensors and bio-analytical sensor: electrochemical bio-sensing, thermal (calorimetric), optical and piezoelectric. The electrophysiology of bio potential signals: ECG, EEG, EMG, EOG, ERG etc.

Prerequisite: 2182450

218 1516	**Introduction to Biomedical Engineering**	**(2-0-1)**

History of biomedical engineering, biomedical engineering degree requirements, medical and biomedical terminologies, disciplines of biomedical engineering. Discussions of design problems, challenges and future directions in biomedical engineering. Guest lectures by practicing biomedical engineers and medical practitioners, student seminars and group learning activities. Moral and ethical issues in biomedical engineering. Visits and trips to hospitals and seminars.

Prerequisite: None

2183550	**Biomaterials Basics And Applications**	**(3-0-3)**

Introduction to biomaterials, structure and properties of materials, crystalline and non-crystalline materials, properties of biological materials, tissue response to implants (biocompatibility). Metallic implant materials – properties and applications. Ceramic implant materials – properties and applications. Polymeric implant materials – properties and applications, polymerization. Composite implant materials. Applications and major considerations of materials in various areas, such as cardio-vascular, ophthalmologic, orthopedic, dental implants.

Prerequisite: 217 1410, 2182420

218 3560	**Biomechanics**	**(3-0-3)**

Basics of Anatomy and Mechanics, Applications involving forces and moments, Statics: Analysis of systems in equilibrium: Applications to human joints: Properties of deformable bodies: Basics of Dynamics, Impulse and momentum, Applications from real-life problems: Applications to various sports, Contemporary issues: Motion analysis.

Prerequisite: 217 1210, 218 2420		
218 3610	**Medical Electronics**	**(2-2-3)**
Amplifiers and Filters: Analysis of ideal op-amp circuits, parameters of practical op-amps. Op-amp applications: Inverting, non-inverting amplifiers, differential amplifier. Common mode rejection ratio, instrumentation amplifiers, comparators, rectifiers, peak detectors, logarithmic amplifiers, integrators, differentiators and active filters, order of a filter LPF, HPF, BPF, BRF, notch filter. Bio-potential amplifiers: Design of amplifiers for ECG, EMG, EEG. Design of power system in medical electronics, Single phase and three phase power system, regulators, isolated power supplies and switched power supplies, uninterrupted power supply (UPS). Transient voltage protection, under and over voltage protection, power failure warning. Multi vibrator, Oscillator circuits, ADC, DAC and data acquisition circuits. *Prerequisite: 218 2330, 218 2450*		
2183650	**Medical Instrumentation I**	**(3-0-3)**
Medical instruments design, Electrocardiograph systems, Bio-potential amplifiers Electroencephalograph Systems, Electromyograph Systems. Other bio-potential signals: ERG, EOG, EGG. Blood Pressure Measurement: Heart mechanics and blood pressure, non-invasive methods, invasive methods, pressure transducers, transducer calibration and amplifier circuits. Blood flow and cardia output measurement techniques. Pacemakers, Defibrillators, cardioverters, uses of external defibrillators and implantable defibrillators. Electro-Surgical Units: SU electrodes, ESU modes, ESU circuits, ESU safety and testing. Ventilators and Respirators: Need for ventilator therapy; terms and definition, modes of operation, block diagram and plethysmographs. *Prerequisite: 218 3610, 218 3460*		
2184760	**Bio-Signal Processing**	**(3-2-4)**
Nature of Biomedical Signals, Discrete signals, Discrete systems: Discrete systems operation, linearity, time invariance, causality, digital filters (FIR and IIR) realizatiin digrams. Digital Convolution: Analytical evaluation of discrete convolution, convolution of finite sequences Frequency Response: Discrete Time Fourier Transform(DTFT), Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT). Z-transform and Design of Digital Filters: IIR filter design by approximating a CT filter, IIR filter design by impulse invariance, IIR filter design, FIR filter design, Frequency-Band transformations, Biomedical applications of digital filtering. Nonlinear Models of Biomedical Signals. DSP Programing exercises using Matlab. *Prerequisite: 218 3756*		
2184710	**Medical Imaging Systems I**	**(3-0-3)**

Radioactivity, Radioactive processes and conservation laws, alpha, beta and gamma decay. Production of radioisotopes, Methods of radio nuclide production and half-lives. Interaction of neutrons. Radiation dosimetry, Calculation of radiation dose. Detection of radiation Gas-filled detectors. Scintillation detectors.X - Ray Physics: Fundamentals of X-Ray, X–Ray tube, Characteristic X-rays and auger electron, interactions between X-rays and matter, intensity of an X-ray beam, attenuation, principles, generation, detection of X-ray. X-ray Image Characteristics, X-ray diagnostic methods Fundamentals of x-ray tomography, Projection function, CT image reconstruction techniques, X-ray computed tomography system. Gamma camera, Basic principle. Introduction to SPECT and PET. Biological effects of radiation and safe handling of radio-nuclides

Prerequisite: 218 2450

2184660	**Medical Instrumentation II**	**(3-2-4)**

Medical Lasers and their applications. Ventilators, respirators and spirometers. Hemodialysis machines: principle of operation, components, blocks diagram and safety. Anesthesia delivering systems Operation room equipment: Electrosurgical Units (ESU), laparoscopic equipment, Infusion pumps, heart-lung machine. Medical lighting systems and standards, Computer networking in hospitals, Hospitals design standards, Health-care planning and managing procedures, Dental equipment and Hospital furniture. Biomedical safety – Electrical Protective devices.

Prerequisite: 218 3650

218 4720	**Biomedical Imaging System II**	**(3-2-4)**

T scan: X-ray imaging system components, projection function, CT image reconstruction techniques; CT scan machines generations, and CT scan system hardware components. Medical Ultrasound Imaging: Fundamentals of ultrasound, Generation (piezoelectric transducers), reflection, attenuation and detection of ultrasound. Ultrasonic diagnostic imaging modes (A, B, M and C modes). Magnetic resonance imaging (MRI): Magnetic resonance imaging: fundamentals: spin density, FID, relaxation times. Imaging: slice selection, frequency encoding, phase encoding, multiple slice, repetition time, time to echo. MRI machine components: Magnet, gradient coils, computer based image reconstruction. Biological effects of magnetic fields: static magnetic fields, radio frequency fields, gradient magnetic fields. Research topics in recent developments in medical imaging and Safety issues in medical imaging.

Prerequisite: 218 4710

218 4960	**Directed Studies In BME**	**(3-0-3)**

The course permits students to investigate possible research fields or pursue topics of interest through reading, presentation and seminars under the supervision and guidance of a faculty member. Broad biomedical knowledge in areas such as: Recent biomedical

engineering developments, Contemporary issues, Impact of biomedical solutions on society, Professional and ethical issues in biomedical engineering, Emerging technologies in biomedical engineering, Professional development of biomedical engineers, Integration of technologies to solve biomedical problems
In addition to the above areas students can suggest specific topics of interest to them.

Prerequisite: 95 Cr. Hrs.

2171010	**Engineering Mathematics I**	**(3-0-3)**

Limits of functions, theorems about limits, evaluation of limit at a point and infinity, continuity. Derivatives of algebraic and trigonometric functions, maxima and minima, engineering applications of derivatives. The definite and indefinite integrals and their applications. Integration by parts, Integration using powers of trigonometric functions, Integration using trigonometric substitution, Integration by partial fractions. Integration of improper integrals. Transcendental Functions.

Prerequisite: None

2171020	**Engineering Mathematics II**	**(3-0-3)**

Matrix addition, subtraction, multiplication and transposition. Complex numbers, algebraic properties of complex numbers, absolute values, complex conjugate, polar representation, powers and roots. Functions of several variables. Double and triple integrals in rectangular and polar coordinates. Applications of multiple integrals in engineering. Infinite sequences, tests for convergence, power series expansion of functions, Taylor series, Laurent series, Fourier series and their applications in engineering.

Prerequisite: 2171010

2171210	**Engineering Physics I**	**(3-2-4)**

Vectors, motion, and Newton's laws. Work, energy, momentum and conservation of momentum. Rotation of rigid bodies, dynamics of rotational motion. Equilibrium and elasticity. Stress and strain. Periodic motion. Engineering applications.

Prerequisite: None

2171220	**Engineering Physics II**	**(3-2-4)**

Electric charge and electric field. Coulomb's law and Gauss's law with applications. Capacitance and dielectrics. DC circuits. Magnetic fields. Ampere's law and its applications. Electromagnetic induction, Faraday's law, Lenz's law, induced electric fields. Self- and mutual-inductance. Electromagnetic waves and Maxwell's equations. Optics and its engineering applications.

Prerequisite: None

2171410	**Chemistry for Engineers**	**(2-2-3)**

Atoms, molecules, ions and formulas of ionic compounds. Electronic structure and the periodic table. Quantum numbers, energy levels and orbital. Orbital diagrams of atoms. Various types of bonds. Chemistry of the metals and semiconductors. Introduction to

organic chemistry, bonding and types of hybridization in carbon atom, alkanes and cyclo alkanes, alkyl and halogen substituents. Alkenes and alkynes, Diels-Alder reaction. Types, properties, and use of polymers. *Prerequisite: None*		
2172030	**Engineering Mathematics III**	**(3-0-3)**
Vector Calculus and its engineering applications. First order differential equations. Homogeneous linear second-order differential equations with constant and variable coefficients, non-homogeneous linear second-order differential equations with constant coefficients, higher-order linear differential equations with constant coefficients. Power series solution of differential equations. Laplace Transform, Inverse Laplace Transform. Application of Laplace Transform to solve ordinary differential equations. Introduction to partial differential equations (PDEs), first order PDEs, second order PDEs, boundary value problems, engineering applications. *Prerequisite: 2171020*		
2172040	**Engineering Mathematics IV**	**(3-0-3)**
Linear Algebra: Matrices and determinants, solution of systems of linear equations, eigenvalues and eigenvectors, engineering applications, computer exercises. Complex Analysis: Complex functions, derivative of complex functions, analytic functions, Cauchy-Riemann equations, harmonic functions. Fourier analysis: Fourier Series, Fourier Integrals, Fourier series of even and odd functions with applications. Discrete Mathematics and its engineering applications. *Prerequisite: 2172030*		
2131400	**Computer Programming**	**(3-0-3)**
Problem solving using flowcharts, structure of a C++ program, data types, operators, variables and constants. Input and output, output formatting. Control Statements: IF and SWITCH, WHILE, DO-WHILE and FOR statements. Function definition and calling, library functions, arrays and strings, pointers. File input and output. *Prerequisite: 1041100*		
2132350	**Logic Design**	**(3-2-4)**
Basic theorems and properties of Boolean Algebra and Boolean functions. Simplification of Boolean functions: Karnaugh Map and Tabulation Method. Product of Sums (POS) and Sum of Products (SOP) forms. Combinational logic circuits: Design and analysis procedures. Decoders, encoders, multiplexers, demultiplexers, ROM, PLA and PAL. Sequential logic circuits: Flip Flops (RS, D, JK, T), design procedure for clocked sequential circuits, counters. Registers and shift registers. *Prerequisite: 1041100*		
2133330	**Microprocessors and Microcontrollers**	**(3-2-4)**

Introduction to microprocessor and its internal architecture. Typical microprocessor bus systems. Addressing modes and address decoding. Memory and I/O interface. Assembly language programming. Microcontrollers and embedded systems. Programming of microcontroller using C language. Interrupt processing and interrupt-based control. Microcontroller interfacing to real-world applications. Design and implementation of course projects using a microcontroller. *Prerequisites: 2132350*		
2122210	**Signals and Systems**	**(3-0-3)**

2132290	**Circuit Analysis**	**(3-2-4)**
Basic quantities: charge, current, voltage, resistance, energy and power. Analysis of series, parallel and series-parallel D.C. resistive circuits using Ohm's law, Kirchhoff's voltage and current laws. Star-Delta and Delta-Star Transformations. Analysis of more resistive circuits using loop and nodal methods, superposition, source transformation, Thevenin's and Norton theorems, maximum power transfer theorem. Transient analyses of RC, RL, and RLC circuits with DC excitation. *Prerequisites: 217 1010, 2171220*		
2182330	**Electronic Circuits**	**(3-2-4)**
Basic properties of semiconductor materials. Theory of operation and applications of p-njunction diodes, zener diodes and photodiodes. Theory of operation, biasing circuits, and small signal analysis of Bipolar Junction Transistor and Junction Field Effect Transistor. Transistor configurations and two-port network representation of transistor a.c. equivalent circuits. Analysis and design of transistor amplifier circuits. *Prerequisites: 2182290*		
218 3920	**Biomedical Design**	**3-2-3**

Engineering Design:
Introduction, basic definitions, design specifications and realistic constraints. Engineering design morphology, types of designs, design method versus scientific method, a problem-solving methodology, considerations of a good design, total life cycle of a product, regulatory and social issues.
Need identification, gathering information, conceptual design, embodiment design, detail design, planning for manufacture, planning for distribution, planning for use, planning for retirement of the product**.** Codes and standards.
Modeling, simulation and prototype, role of models in engineering design, types of models, mathematics. Risk, reliability and safety: reliability theory, reliability of series, parallel and hybrid systems, design for reliability. Quality versus reliability. MTTR, MTTF, MTBF. QA and QC. Ergonomics in engineering design. Bill of materials and product costing. Documentation and presentation. Design of dual power supply, design of ECG, EMG amplifier circuits. Design of microcontroller based biomedical circuits. Design and fabrication of printed circuit board (PCB) for biomedical circuits.

Prerequisites: 218 3610

2184980	**Biomedical Design Project I**	

The course is aimed at the development of conceptual and applied design skills through discussions, meetings and laboratory work involving the completion of a biomedical engineering design project.The project experiences is intended to develop students skill in problem solving, team work , design, innovation, information technology, engineering, medical ethics, and social responsibility. Students are expected to complete a design project that demonstrates the skills and knowledge gained through applying biomedical engineering principles to solve a biomedical design problem.Students work in teams of three to four to solve a biomedical engineering design problem. Every team is required to choose a real-world project. Teams are supervised by faculty members and instructors who oversee and meet weekly with each group.

Every group is required to maintain a record of all project activities in a project logbook which will be inspected weekly by the project supervisor.

Prerequisites: 218 3920

218 4990	**Biomedical Design Project II**	

The course is a continuation of Biomedical Design Project I, aimed at the development of conceptual and applied design skills through discussions, meetings and laboratory work involving the completion of a biomedical engineering design project.The project experiences is intended to develop students skill in problem solving, team work , design, innovation, information technology, engineering, medical ethics, and social responsibility. Students are expected to complete a design project that demonstrates the skills and knowledge gained through applying biomedical engineering principles to solve a biomedical design problem.Students work in teams of three to four to solve a biomedical engineering design problem. Every team is required to choose a real-world

project. Teams are supervised by faculty members and instructors who oversee and meet weekly with each group.

Every group is required to maintain a record of all project activities in a project logbook which will be inspected weekly by the project supervisor.

Prerequisites: 218 4980

218 5110	**Artificial Organs**	**(3-0-3)**

Major types of artificial organs and prosthesis, artificial heart and circulatory assist devices. Cardiac valves, artificial lungs and blood-gas exchange devices, artificial kidney; types of dialysis. Liver support systems, aphaeresis and blood fractionation, artificial blood, artificial skin and dermal equivalents. Artificial pancreas, prosthetics and orthotics; artificial limbs. Major joint implants and dental Implants.

Prerequisite: 218 2450

218 5140	**Rehabilitation Engineering**	**(3-0-3)**

Introduction to rehabilitation engineering, definition, history, patho-physiology components, disability, categories, physical impairment, speech impairment, disabilities and symptoms, rehabilitation engineering technology, assistive devices, transportation, wheel chair, enhance mobility, physiological and biomedical measurement techniques, sensors, disability assessment, application of rehabilitation engineering, physiological medical social prosthetics & orthotics. An introduction to the human body -basic anatomical terminology, anatomical positions, regional Names, directional terms, body cavities, abdomino-pelvic quadrants.

Prerequisites: 218 3560, 218 2450