DEPARTMENT OF BIOMEDICAL ENGINEERING

SUBJECT WISE COURSE OUTCOMES (2022 – 2023)

I – SEMESTER

T101 - Mathematics - I		Yr/Sem: I/I
CO 1	To introduce the idea of applying calculus concepts to problems in Engineering .	
CO 2	To familiarize the student with functions of several variables.	
CO 3	To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.	
CO 4	Introduction of effective mathematical tools for the solutions of differential equations that model physical processes	
CO 5	Gain the knowledge to solve first order differential equation arising in engineering.	

T102 - Physics		Yr/Sem: I/I
CO 1	Apply knowledge of science and engineering to understand physics and its significant contribution in the advancement of technology and invention of new products that dramatically transform modern day society.	
CO 2	Identify different areas of physics which have direct relevance and applications to different engineering disciplines	
CO 3	Apply fundamental knowledge to understand applications of ultrasonics, optics and some optical devices, lasers and fiber optics, nuclear energy sources and wave mechanics.	
CO 4	Understand the basic operating principles of laser, its applications, optical fiber, and its types, transmission characteristics, applications of optical fibers.	
CO 5	Understand the basic operating principles of laser, its applications, optical fiber, and its types, transmission characteristics, applications of optical fibers.	

T103 - Chemistry		Yr/Sem: I/I
CO 1	Apply knowledge of science and engineering to understand the importance of chemistry in engineering domain.	
CO 2	Identify different electrochemical cells and their usage for industrial process.	
CO 3	Apply fundamental knowledge of chemistry and build an interface of theoretical concepts with industrial applications/engineering applications.	
CO 4	Guide the students to gain the knowledge about the cooling curves , phase diagrams, alloys and their practical importance.	
CO 5	Strengthen the fundamentals of chemistry and then build an interface of theoretical concepts with their industrial/engineering applications.	

T110 - Basic Civil and Mechanical Engineering		**Yr/Sem: I/I**
CO 1	Understand the building classification as per National building code.	
CO 2	Get the idea about construction procedure for various components of the building.	
CO 3	Students understand the principles of surveying, construction procedure for roads, bridges and dams.	
CO 4	Student will be able know about the working of Internal and external combustion systems	
CO 5	Student will be able know about Non-Conventional Energy Systems	
CO 6	Student will be able to know about manufacturing process.	

T111- Engineering Mechanics		**Yr/Sem: I/I**
CO 1	Understand the basic laws of mechanics and resolution of forces using different methods.	
CO 2	Learn and apply the knowledge on analysis of forces acting on the trusses and effect of friction force on bodies.	
CO 3	Learn about the centroid and moment of inertia for plane and solid figures.	
CO 4	Understand the three laws of motion, principles of dynamics for particles.	
CO 5	The student will able to analyse the laws of motion for rigid bodies.	

T112- Communicative English		**Yr/Sem: I/I**
CO 1	Learnt about the definition of communication, importance, concept. Sender, Ideation, the levels in communication, channels, oral and written way of communication, body language and non verbal communication, Accuracy, Brevity and Clarity, different barriers for Communication, techniques in making effective communication, listening importance and types of listening.	
CO 2	Students learnt about the types of letters, report writing, notices and memo and also developed their skill in writing.	
CO 3	Understands the comprehension, identifies the difference between Skimming and scanning, guess the meaning of the words, Identify to make notes.	
CO 4	Students learnt the writing skills, how to write a paragraph in a proper manner, four modes of writing and how to make bibliographical entries.	
CO 5	Students were able to develop their spoken skills by making them to involve in many activities related to it.	

P 104 – Physics Lab		**Yr/Sem: I/I**
CO 1	Able to understand how to find the thickness of the specimen and also to find the radius of curvature of glass using the phenomenon of interference of light	
CO 2	Able to understand the specific rotatory power of an optical active solution using the principle of polarization.	
CO 3	To understand about the thermal conductivity of bad conductor and rubber tube.	
CO 4	Ability to understand about the optical properties like dispersive power, Resolving power by applying the knowledge of optics	
CO 5	To acquire knowledge about the magnetometer due to current coil and jolly method of determining the pressure coefficient of air at constant volume.	
CO 6	Ability to understand the basic knowledge of inference ,polarization ,Magnetic	

	materials ,thermal conductivity that correlates the theory and practical

P 105 – Chemistry Lab   **Yr/Sem: I/I**

CO 1	Students will become well acquainted to test amount of hardness present in sample of water for their engineering needs.
CO 2	Students will be efficient in estimating acidity/alkalinity in given samples.
CO 3	Students will have knowledge about estimating amount of dissolved oxygen in water.
CO 4	Students will become well acquainted to estimate copper in brass.
CO 5	Students will have knowledge about determination of viscosity of sucrose using Ostwald"s viscometer.
CO 6	To develop an understanding of basic titration setup and methodologies for determining strength, hardness and alkalinity of various unknown solutions

P 106 – Workshop Practice   **Yr/Sem: I/I**

CO 1	Understand and comply with workshop safety regulations.
CO 2	Student will be able to make various joints in the given object with the available work material.
CO 3	Student will be able to know how much a joint will take for the assessment of time.
CO 4	Students can able to Identify the hand tools and instruments.
CO 5	Students can able to gain knowledge about various operations carried out in sheet metal.
CO 6	Students can able to gain skills about various tools used in welding to make simple joints.

II – SEMESTER

T 107 – Mathematics - II   **Yr/Sem: I/II**

CO 1	Apply knowledge of mathematics to solve matrix algebra technique for practical applications and Curl, divergence and integration of vectors in vector calculus.
CO 2	Identify, formulate and solve engineering problems like Laplace transform and to solve differential and integral equations.
CO 3	Apply formulae and analyze problems of Fourier transform techniques.
CO 4	Determine the Fourier transform , Fourier cosine and sine transform of elementary functions, properties of transforms and its application in engineering
CO 5	Acquire knowledge of matrix algebra technique, vector calculus, Laplace and Fourier Transform.

T108 – Material Science   **Yr/Sem: I/II**

CO 1	Apply core concepts in material science to solve engineering problems.
CO 2	Knowledgeable of contemporary issues relevant to material science and engineering
CO 3	Understand about the ferrites and its application to magnetic materials.
CO 4	Select materials for design and construction.
CO 5	Understand the importance and properties of materials.

T109 – Environmental Science   **Yr/Sem: I/II**

CO 1	Apply fundamental knowledge to understand about the environment.
CO 2	Identify environmental pollution through science.
CO 3	Apply basic knowledge to solve various environmental issues and problems.
CO 4	Ability to consider issues of environment and sustainable development in his personal and professional undertakings.
CO 5	Provides a comprehensive knowledge in environmental science, environmental issues and the management from an interdisciplinary perspective.

T104 – Basic Electrical and Electronics Engineering	**Yr/Sem: I/II**
CO 1	Will learn the fundamentals of rotational and stationary machine operation, single-phase and three-phase power measurement, magnetic and electrical circuits, and these topics.
CO 2	Will learn the fundamentals of measuring devices, communication systems, and network models.
CO 3	Knowledge about non-conventional energy systems will be available to students.
CO 4	The varieties of metal joining will be known by the students.
CO 5	Students will learn about numerous engines, energies, and joints as well as construction and building components offered with diverse principles.

T105 – Engineering Thermodynamics	**Yr/Sem: I/II**
CO 1	Apply knowledge of mathematics, science and engineering to understand the basics of thermodynamics.
CO 2	Understand the importance of laws of thermodynamics applied to energy systems.
CO 3	Understanding refrigeration, heat pump and their physical mechanism.
CO 4	Understand the laws of motion for rigid bodies.
CO 5	Understand the effects of forces acting on the bodies in practical situation.

T106 – Computer Programming	**Yr/Sem: I/II**
CO 1	Know concepts in problem solving.
CO 2	To do programming in C language.
CO 3	To write diversified solutions using the C language.
CO 4	To know about structures, pointers and its manipulation.
CO 5	To know about the evaluation of computers, components and its applications. Basic knowledge on the internet, information technology, word processing and worksheets.

P101 - Computer Programming Laboratory	**Yr/Sem: I/II**
CO 1	Students can work with command line interface OS's, like MS-DOS.
CO 2	Students can solve most of the real time problems with C program.
CO 3	Students can interact with computer using C program, through various input and output functions.
CO 4	Students can make a use of various keywords, constants, variables, data types, operators, type conversion in C program.
CO 5	Students will have knowledge about arrays, functions, structures and pointers in C program.

P102 – Engineering Graphics		Yr/Sem: I/II
CO 1	Perform freehand sketching of basic geometrical constructions and multiple views of objects.	
CO 2	Project orthographic projections of lines and plane surfaces.	
CO 3	Draw projections and solids and development of surfaces.	
CO 4	visualize and to project isometric and perspective sections of simple solids.	
CO 5	Students will be able to draw orthographic projections and isometric projections.	

P103 - Basic Electrical and Electronics Laboratory		Yr/Sem: I/II
CO 1	Know about basic electrical tools, applications and precautions	
CO 2	Perform different types of wiring used in domestic and industrial applications.	
CO 3	Measurements of voltage and phase using CRO, basic operation and applications of devices such as PN junction diode and transistors.	
CO 4	Understand the function and applications of basic logic gates and flip flops.	
CO 5	Gain knowledge in domestic wiring and application of electronics device in the field of electrical engineering.	

P107 – NSS/NCC		Yr/Sem: I/II
CO 1	to create awareness in social and environmental issues.	
CO 2	to participate in relief and rehabilitation work during natural calamities.	
CO 3	to develop some proposals for local slum area development and waste disposal.	
CO 4	to create team works among students and produce efficient results.	
CO 5	to operate scientific instruments or advanced software.	

III – SEMESTER

MA T31 – Mathematics – III		Yr/Sem: II/III
CO 1	Identify complex variable function, apply CR equations for testing of analyticity of the complex function.	
CO 2	Construct conformal mappings between regions. Solve problems on bilinear transformation and find the Taylor's and Laurent's series.	
CO 3	Analyze the complex functions with reference to their analyticity, integration using Cauchy's integral theorem and Cauchy's residue theorem.	
CO 4	Express any periodic function as fourier series, fourier sine and cosine series.	
CO 5	Finding fourier series for numerical values of any function. Interpret and use the basic concepts of analytic function, Taylor and Laurent series, singularities, residues, conformal mapping, fourier series an harmonic analysis.	

BM T32 - Electric Circuit Analysis		Yr/Sem: II/III
CO 1	demonstrate a comprehensive understanding of circuit analysis principles, ranging from recalling basic concepts to creating and evaluating complex circuit designs	
CO 2	demonstrating the ability to apply, analyze, and creatively utilize these theorems to solve complex electrical circuit problems	
CO 3	understanding of resonance phenomena, coupled circuits, and three-phase circuits,	

	applying critical thinking skills to analyze, evaluate, and solve complex electrical engineering problems
CO 4	Understanding the transient responses of R-L, R-C, and R-L-C circuits (in series combinations) under step and sinusoidal excitations.
CO 5	Develop a deep understanding of network functions and parameters, including complex frequency concepts, transformed networks, driving point impedance and admittance, transfer functions, poles, and zeros

BM T33 – Electronic Devices and Circuits	**Yr/Sem: II/III**
CO 1	Understanding of PN junction diodes, encompassing their structure, operation, and V-I characteristics, as well as diffusion and transient capacitance phenomena.
CO 2	Understanding of semiconductor devices, including BJT, JFET, and MOSFET, covering their structures, operations, characteristics, and biasing techniques.
CO 3	Analyze BJT and MOSFET small signal models, evaluate amplifier gain, frequency responses, and conduct high-frequency analysis, showcasing advanced analytical and problem-solving skills.
CO 4	Analyze BIMOS cascade amplifiers, differential amplifiers, FET input stages, single-tuned amplifiers, and power amplifiers.
CO 5	Analyzing various oscillators including Wien bridge, Hartley, Colpitts, and Crystal oscillators, showcasing advanced analytical skills.

BM T34 - Human Anatomy and Physiology	**Yr/Sem: II/III**
CO 1	Describe basic structural and functional elements of human body
CO 2	Explain the function of cardiovascular system and knowledge on nervous systems
CO 3	Distinguish the types of skeletal systems and functions of respiration
CO 4	Illustrate the Physiological function of Digestive and Excretory systems
CO 5	Elucidate special senses in the human body

BM T35 – Data Structures and Object Oriented Programming	**Yr/Sem: II/III**
CO 1	Select of relevant data structures and combinations of relevant data structures for the given problems in terms of memory and run time efficiency.
CO 2	Apply data abstraction in solving programming problems.
CO 3	An ability to conceptualize the problem in terms of object oriented features
CO 4	An ability to use the OO programming techniques(C++) in developing applications.
CO 5	An ability to design and develop a complete object oriented applications

BM T36 – Bio Chemistry	**Yr/Sem: II/III**
CO 1	Comprehend the intricate biochemistry of living cells, including subcellular fractionation methods, organelle functions, redox potential, oxidative phosphorylation, and biological membrane transport mechanisms.
CO 2	Understand the chemical nature, properties, and measurement techniques of enzymes, along with the study of hormones, their properties, assays, and significance in physiological processes.
CO 3	knowledge of carbohydrates, lipids, and proteins, focusing on their classification, metabolism, structural aspects, and various analytical techniques like chromatography

	and electrophoresis.
CO 4	Conducting essential biochemical analyses, including liver and renal function tests, blood gas analysis, and the interpretation of abnormal values in various physiological conditions.
CO 5	Remember the principles and applications of advanced biochemical techniques such as photometry, spectrophotometry, fluorometry, and calorimetry, as well as gain expertise in utilizing isotopes and automation in clinical laboratory settings.

BM P31 – Electronic Devices and Circuits Lab	Yr/Sem: II/III
CO 1	Understand and analyze the characteristics of PN junction diodes, Zener diodes, FETs, SCRs, DIACs, and TRIACs, as well as measure h-parameters of transistors in various configurations.
CO 2	Demonstrate expertise in rectifier circuits, amplifiers (CE, CC, and FET), oscillators (Wien Bridge, RC Phase Shift, Hartley, and Colpitts), and waveform shaping circuits (clippers, clampers, and RC wave shaping circuits).

BM P32 – Biochemistry and Human Physiology lab	Yr/Sem: II/III
CO 1	Performing general tests for carbohydrates, proteins, and lipids, as well as preparing serum and plasma from blood samples.
CO 2	Demonstrate proficiency in estimating blood glucose, creatinine, urea, cholesterol, and liver enzyme levels (SGOT/SGPT).
CO 3	Analyze blood parameters such as ESR, PCV, MCH, MCV, MCHC, total RBC count, and hemoglobin levels, showcasing advanced laboratory techniques and analytical abilities.

BM P33 – Data structures and Object Oriented Programming Lab	Yr/Sem: II/III
CO 1	Implementation of algorithms and data structures in C
CO 2	Implementation of object-oriented concepts in C++

IV – SEMESTER

MA T41 – Mathematics – IV	Yr/Sem: II/IV
CO 1	Formulate and solve partial differential equation.
CO 2	Derive and obtain the solution of wave equation and boundary value problems.
CO 3	Derive and obtain the solution of heat equation and boundary value problems.
CO 4	Apply least square method to fit various curves for the given data investigate the validity of hypothesis by Z-distribution techniques.
CO 5	Calculation of analysis of variance and explain the use of the Chi-squared test and its calculation.

BM T42 – Medical Physics	Yr/Sem: II/IV
CO 1	Comprehend the electromagnetic spectrum, understand the physics of light, ultrasound fundamentals, and the interaction of ultrasound with materials, providing a foundation for medical applications.
CO 2	Remember the principles of radioactive decay, nuclear physics, and the production of

	radionuclides, enabling them to apply this knowledge in medical and technological contexts.
CO 3	Understanding of the interaction of radiation with matter, including charged particles and gamma radiations, enhancing their knowledge of radiation therapy and its impact on biological systems.
CO 4	Explain the physics of the cardiopulmonary system, including lung volume measurement, cardiovascular system components, and blood flow dynamics, facilitating their understanding of physiological processes.
CO 5	Analyzing radiation effects, encompassing acute and delayed effects, radiation syndromes, stochastic, and deterministic effects, enabling them to assess and mitigate the impact of radiation exposure on human health.

BM T43 – Digital Logic Theory and Design	Yr/Sem: II/IV
CO 1	Explain minimization techniques and logic gates, including Boolean algebra, Hamming codes, De-Morgan's Theorem, Karnaugh map minimization, and implementations of logic functions using gates, enabling them to design and optimize digital circuits efficiently.
CO 2	Proficient in designing various combinational circuits such as adders, subtractors, multipliers, dividers, multiplexers, demultiplexers, encoders, decoders, and comparators, demonstrating advanced skills in digital circuit design.
CO 3	Understanding in sequential circuits, including latches, flip-flops, counters, shift registers, and memory devices.
CO 4	Comprehend the classification, design, and analysis of synchronous and asynchronous sequential circuits, including the use of Algorithmic State Machine and addressing problems in asynchronous circuits.
CO 5	Understand the classification and organization of memory devices, including ROM, RAM, and programmable logic devices (PLA, PAL, FPGA).

BM T44 – Electrical and Electronic Instruments	Yr/Sem: II/IV
CO 1	The students will be able to understand and design of digital circuit and its principle.
CO 2	The students will be able to explain the working of various sequential circuits.
CO 3	Understand the digital Logic families and relevant ICs and its usages.
CO 4	The student will understand algorithmic state machines and threshold logic and its usages.
CO 5	Understand the working of oscilloscope, recorders and displays.

BM T45 – Linear Integrated Circuits	Yr/Sem: II/IV
CO 1	Design simple circuits like amplifiers using Opamps.
CO 2	Design waveform generating circuits.
CO 3	Design simple filters circuits for particular application.
CO 4	Gain knowledge in designing stable voltage regulators.
CO 5	Gain knowledge in designing A-D and D-A converters.

BM T46 – Biomedical Sensors and Transducers	Yr/Sem: II/IV
CO 1	Classify systems modeling biomedical sensors and instrumentation.
CO 2	Calculate the static and dynamic characteristics of bio instrumentation systems.

CO 3	Analyze fluid mechanics models currently used for clinical research problems.
CO 4	Classify the different types of electrodes and their applications.
CO 5	Understand the working of biochemical transcducers.

BM P41 – Linear and Digital Integrated Circuits Lab	**Yr/Sem: II/IV**
CO 1	Conduct and understand the operations of IC 741, IC 555, IC 565, IC 723
CO 2	Understand the performance of Flip flop, counter, register, decoder, comparator, multiplexer, RAM and LED drive.

BM P42 – Biomedical Sensors and Transducers lab	**Yr/Sem: II/IV**
CO 1	Understand and analyze various types of transducers, including temperature, displacement, optical, and electrochemical transducers, assessing their operational principles and applications critically.
CO 2	Apply theoretical knowledge to practical scenarios, demonstrating proficiency in measuring parameters like temperature, pressure, strain, and skin resistance using specific transducers, and interpreting results accurately for relevant applications.

BM P43 – Simulation Lab	**Yr/Sem: II/IV**
CO 1	design and analysis of various electronic circuits including amplifiers, oscillators, multivibrators, and signal processing elements.
CO 2	Emphasizes experimental verification of fundamental theorems, two-port network parameters, inductance properties, and implementation of active filters, converters, multipliers, and digital logic gates.

BM P44 – Physical Education	**Yr/Sem: II/IV**
CO 1	Understanding the opportunities of students' physical, cognitive, social and emotional development.
CO 2	Understanding of individual and group motivation and behavior.
CO 3	To create teamwork among students and produce efficient results.
CO 4	The students were taught to operate advanced playing kits.
CO 5	to motivate the students to prepare the professional and scientific reports

V – SEMESTER

BM T51 – Probability and Random Processes	**Yr/Sem: III/V**
CO 1	Fundamental knowledge of the basic probability concepts.
CO 2	Knowledge of standard distributions which can describe real life phenomena.
CO 3	Acquire skills in handling situations involving more than one random variable and functions of random variables.
CO 4	Understand and characterize phenomena which evolve with respect to time in probabilistic manner.
CO 5	Analyze the response of random inputs to linear time invariant systems.

BM T52 – Bio Control Systems	Yr/Sem: III/V

CO 1	Introduces control system basics, including open and closed loop systems, with a focus on examples and classification.
CO 2	Covers time response analysis for first and second order systems, addressing standard test signals, transient and steady-state responses, and the impact of control parameters.
CO 3	Explores stability concepts, including Routh stability criterion and root locus analysis, emphasizing how pole and zero placements affect system stability.
CO 4	Discusses frequency response analysis techniques such as Bode diagrams, Nyquist plots, and Nichols Chart, analyzing stability and system behavior in the frequency domain.
CO 5	Examines physiological control systems, highlighting differences from technological systems and detailing specific mechanisms regulating various physiological processes.

BM T53 – Pathology and Microbiology	Yr/Sem: III/V

CO 1	**Remember:** Recall fundamental concepts of cell injury, necrosis, apoptosis, and inflammation.
CO 2	**Understand:** Explain the mechanisms behind edema, thrombosis, and shock in fluid and hemodynamic derangements.
CO 3	**Apply:** Apply various microscopy techniques to identify and observe bacterial cultures effectively.
CO 4	**Analyze:** Analyze genetic disorders, immune responses, and different types of infections, including viral, bacterial, fungal, protozoal, and helminthic diseases.
CO 5	**Evaluate:** Evaluate staining and antigen-antibody techniques for identifying disease-causing organisms, demonstrating critical assessment skills in laboratory procedures.

BM T54 – Microprocessor and Its Applications	Yr/Sem: III/V

CO 1	Recall the fundamental aspects of 8085 microprocessor, including its architecture, functional block diagram, memory mapping, addressing modes, and instruction set.
CO 2	Understand data transfer instructions, arithmetic and logic operations, assembly language programming, subroutine handling, and debugging techniques for 8085 microprocessor.
CO 3	Apply knowledge to interface 8255, 8253, 8259, 8155, 8279, and 8251 with 8085, as well as understand serial communication, data converters (ADC and DAC), and DMA controllers.
CO 4	Analyze the architecture of 8086 microprocessor, addressing modes, instruction set, and perform assembly language programming involving logical operations, branching, sorting, and arithmetic expressions.
CO 5	Evaluate applications of microprocessors, including interfacing with devices like seven-segment displays, LCDs, stepper motors, temperature sensors, and strain gauges, and implementing functions such as frequency measurement and traffic control.

BM T55 – Medical Instrumentation	Yr/Sem: III/V

CO 1	**Understand:** Understand the functioning of basic components such as bio-potential electrodes, electrode-electrolyte interfaces, and different types of amplifiers, essential for foundational knowledge in biomedical engineering.

CO 2	**Apply:** Apply measurement techniques for physiological parameters (ECG, EEG, EMG, etc.) to interpret and analyze physiological signals, crucial for accurate diagnosis and patient monitoring.
CO 3	**Evaluate:** Evaluate the application of imaging systems (ultrasound, X-ray, CT scan, MRI, PET scan) and biotelemetry systems in healthcare, analyzing their effectiveness and potential impact on patient care and diagnostics.
CO 4	**Analyze:** Analyze the mechanisms and outcomes of therapeutic equipment (diathermy, pacemakers, defibrillators, etc.), assessing their effectiveness and potential risks in various medical conditions.
CO 5	**Apply:** Apply safety protocols and preventive measures to minimize electrical and radiation risks in biomedical settings, ensuring patient safety and equipment reliability.

BM E56 – Elements of Biotechnology	**Yr/Sem: III/V**
CO 1	Recall the basic definition of biotechnology, its interdisciplinary nature, and the public perception of biotechnology's role in the developing world.
CO 2	Understand the structure and function of proteins, protein-protein interactions, enzyme properties, and their applications in various fields, including enzyme production techniques and immobilization methods.
CO 3	Apply knowledge of biotechnology in medicine, including pharmaceuticals, gene therapy, and environmental applications like microbial ecology, wastewater treatment, and bioremediation.
CO 4	Analyze industrial genetics, genetic engineering techniques, bioinformatics applications, and potential biohazards, emphasizing ethical concerns related to genetic engineering practices.
CO 5	Evaluate the impact of biotechnology in agricultural practices, focusing on plant biotechnology, diagnostics, and applications in food and beverage industries, including fermentation processes and microbial-derived products.

BM P51 – Medical Instrumentation Lab	**Yr/Sem: III/V**
CO 1	Gain expertise in designing and analyzing biological pre-amplifiers, mastering noise reduction techniques and ensuring precise signal integrity for biomedical data acquisition.
CO 2	Develop advanced skills in recording, interpreting, and analyzing ECG, EMG, and EEG signals, along with proficiency in monitoring diverse physiological parameters using telemetry systems, enabling comprehensive patient assessment and diagnostic capabilities in various medical applications.

BM P52 – Pathology and Microbiology Lab	**Yr/Sem: III/V**
CO 1	analyze urine samples, identifying protein, reducing substances, ketones, bilirubin, and blood components, crucial for diverse medical diagnoses.
CO 2	Master the use of compound microscopes and practical techniques like tissue processing, cryosectioning, and staining methods, ensuring accurate laboratory analysis and pathology examination.

BMP53 – Microprocessor & its Applications Lab	**Yr/Sem: III/V**

CO 1	Program 8085 and 8086 microprocessor kits and implement interfaces for devices like interrupt controllers, displays, A/D converters, and stepper motors, ensuring versatile microprocessor system development.
CO 2	Perform advanced interfacing techniques for keyboards, programmable timers, and traffic light controllers, enhancing control precision and enabling seamless integration of diverse devices in microprocessor applications.

BMP 54 – General Proficiency – I   **Yr/Sem: III/V**

CO 1	To understand and practice the art of communication
CO 2	able to practice and showcase soft skills.
CO 3	To understand the importance of writing.
CO 4	To practice speaking skill.
CO 5	To practice verbal, non verbal and numerical aptitude.

VI – SEMESTER

BM T61 – Diagonstic and Therapeutic Equipments   **Yr/Sem: III/VI**

CO 1	Master the operation and interpretation of cardiac devices, including ECG machines and pacemakers, demonstrating expertise in heart wave analysis and pacemaker functionalities.
CO 2	Understand EEG significance and utilize EEG systems for conditions like epilepsy, gaining proficiency in evoked potentials interpretation and neurodiagnostic techniques.
CO 3	Learn EMG waveform analysis and neuromuscular diagnostic techniques, enhancing skills in muscle and nerve stimulators and fatigue assessments.
CO 4	Develop proficiency in respiratory diagnostics using spirometers, plethysmography, and ventilators, mastering airway resistance measurements and various ventilator types.
CO 5	Explore patient monitoring systems, ICU equipment, and extracorporeal technologies, gaining expertise in diverse medical procedures and diagnostic applications.

BM T62 – Telemedicine   **Yr/Sem: III/VI**

CO 1	Gain insights into telemedicine's history, definitions, scope, and benefits, along with ethical considerations, exploring its evolution, applications, and limitations in healthcare.
CO 2	Understand various information types and communication networks, including audio, video, and data transmission, and delve into real-time telemedicine integration, emphasizing network configurations, encryption protocols, and adherence to standards like DICOM and HL7.
CO 3	Explore network configurations, circuit and packet switching, and video conferencing technologies, focusing on encryption methods and data security protocols like TCP/IP and ISO-OSI, ensuring secure and efficient telemedicine communication.
CO 4	Examine the ethical and legal aspects of telemedicine, including patient confidentiality and consent, while understanding encryption mechanisms and protocols like DICOM and HL7 to maintain data security and privacy.
CO 5	Explore specialized fields like teleradiology, telepathology, telecardiology, oncology, and telesurgery, emphasizing the components of imaging systems, multimedia

	databases, and secure communication networks, ensuring accurate diagnosis and treatment in specialized telemedicine practices.

BM T63 – Biomedical Signal Processing   **Yr/Sem: III/VI**

CO 1	Master classification and representation of discrete-time signals, study system representation, convolution, sampling, quantization, and signal reconstruction techniques.
CO 2	Develop expertise in DTFT, Z-transform, and filter design, exploring frequency response, ideal filters, system realization, and stability criteria.
CO 3	Proficiently handle DFT and FFT algorithms, understanding circular convolution, parameter selection, and their applications in signal processing.
CO 4	Understand FIR and IIR filter design, including linear phase characteristics, windowing, and frequency sampling methods, applying them to digital signal processing.
CO 5	Apply digital signal processing in biomedical fields, focusing on noise reduction, QRS detection, arrhythmia analysis, EEG analysis, and data reduction techniques for precise biomedical signal interpretation.

BM T64 – Embedded System Design   **Yr/Sem: III/VI**

CO 1	Foundational knowledge in activating and using a generic microcontroller. Preliminary design considerations for system level implementation.
CO 2	Knowledge of 8051 Microcontroller hardware features and internal peripherals. Programming knowledge of 8051 microcontrollers.
CO 3	Knowledge of ARM Processor hardware features and internal peripherals. Programming knowledge of ARM Processors.
CO 4	Software design techniques to be followed for embedded system designing.
CO 5	Using real time operating systems for embedded systems.

BM T65 – Medical Informatics and Expert System   **Yr/Sem: III/VI**

CO 1	Explore the basics of Medical Informatics, including internet applications, security concerns, computer-based medical information retrieval, and integration with Health Informatics and Bioinformatics.
CO 2	Study Computerized Patient Records (CPR), covering history-taking methods, CPR components, and applications in radiology, clinical information systems, and computerized prescriptions.
CO 3	Examine automated clinical laboratories, intelligent Laboratory Information Systems, and computer-assisted medical imaging techniques in fields like nuclear medicine and Nuclear Magnetic Resonance.
CO 4	Delve into advanced technologies like Neurocomputers, Artificial Neural Networks, Expert Systems, and Computer-Assisted Decision Support Systems, applying them in clinical decision-making and surgery.
CO 5	Explore innovative trends such as Virtual Reality applications, Computer-Assisted Surgery, Telemedicine, Tele-surgery, and computer aids for the handicapped in the context of Medical Informatics.

BM E63 – Medical Imaging Techniques   **Yr/Sem: III/VI**

CO 1	Understanding of fundamental imaging principles and techniques in X-ray imaging.
CO 2	Master principles of CT imaging, focusing on machine operation, image acquisition, and quality considerations.
CO 3	Gain expertise in ultrasound technology, covering scanning modes, tissue characterization, and color Doppler imaging.
CO 4	Explore radionuclide imaging methods, including SPECT, PET, and Gamma ray camera techniques.
CO 5	Comprehend MRI principles, pulse sequences, safety, and applications in functional and electromagnetic resonance imaging.

BM P61 – Diagonstic and Therapeutic Equipments Lab	**Yr/Sem: III/VI**
CO 1	Develop expertise in real-time ECG heart rate monitoring and alarm system integration, ensuring timely detection and response to abnormal cardiac activities.
CO 2	Master computerized pulmonary function tests, specifically spirometry, enabling accurate assessment of lung function and respiratory health in clinical settings.

BM P62 – Biomedical Signal Processing Lab	**Yr/Sem: III/VI**
CO 1	Master signal generation, correlation, linear/circular convolutions, and spectrum analysis using DFT, along with the design of FIR and IIR filters for diverse applications in signal processing.
CO 2	Develop advanced skills in generating, analyzing, and processing biomedical signals like ECG and arrhythmia, incorporating spectrum analysis, noise removal, QRS component detection, bio-signal isolation, PCG classification, ECG compression, and audiometric threshold measurement, enhancing proficiency in medical signal analysis and interpretation.

BM P63 – System Design Using Microcontrollers Lab	**Yr/Sem: III/VI**
CO 1	Master diverse programming skills including data transfer, sorting, arithmetic operations, control structures, boolean instructions, and code conversion, with a focus on 16-bit arithmetic operations and bit-addressable tasks, along with implementing delay generation, serial communication, and timer/counter operations.
CO 2	Develop proficiency in interfacing 8051 microcontroller with various modules, enabling tasks such as calculator operations, alphanumeric LCD display, hex keypad input, external ADC integration, temperature control, waveform generation, and control of stepper motors and DC motors, creating comprehensive single-chip solutions.

BM P64 – General Proficiency – II	**Yr/Sem: III/VI**
CO 1	Understand the composition analysis.
CO 2	Developing letter and resume writing skills.
CO 3	Understand and practice oral skills through group discussions and negotiation activities.
CO 4	Practice corporate etiquette, grooming and dressing.
CO 5	Practice verbal, non-verbal and numerical aptitude.

BM T71 – Biomaterials and Artificial Organs	Yr/Sem: IV/VII

CO 1	Explore the fundamental concepts of bio-materials, emphasizing their classification, mechanical properties, and biocompatibility, enabling a deep understanding of their role in medical applications.
CO 2	Analyze various implant materials, focusing on their applications in medical contexts, demonstrating practical knowledge and skills in selecting appropriate materials for specific medical needs.
CO 3	Evaluate polymeric implant materials in detail, critically assessing their properties and applications, fostering analytical skills crucial for making informed decisions in implant material selection.
CO 4	Examine tissue replacement implants comprehensively, evaluating their diverse applications and impact on patients' lives, honing the ability to critically evaluate the effectiveness of different implant types.
CO 5	Explore advanced technologies related to artificial organs, emphasizing the design and creation of innovative solutions, fostering creativity and problem-solving skills for developing cutting-edge medical devices.

BM E75 – Radiological Equipment	Yr/Sem: IV/VII

CO 1	Explore X-ray principles, equipment components, digital radiography, and advanced imaging techniques like fluoroscopy and mammography.
CO 2	Understand tomography principles, reconstruction methods, spiral CT scanning, and components of CT systems, including X-ray sources and detectors.
CO 3	Learn MRI basics, relaxation processes, and system components such as magnets, gradient fields, coils, and electronic elements.
CO 4	Study radioisotopes, detectors, gamma cameras, SPECT, PET, and radio pharmaceuticals in nuclear medicine.
CO 5	Explore radiation therapy techniques, protection principles, dosimeters, and practical dose reduction methods following ICRP regulations.

BM E76 – Medical Optics	Yr/Sem: IV/VII

CO 1	Explore tissue interactions with light, including refraction, scattering, absorption, and optothermal effects, and understand phenomena like fluorescence and speckles.
CO 2	Study instruments for absorption, scattering, and emission measurements, including light sources like lasers and LEDs, optical filters, polarizers, and detectors, both time-resolved and phase-resolved.
CO 3	Examine laser applications in various medical fields, such as tissue welding, dermatology, ophthalmology, otolaryngology, and urology.
CO 4	Learn about optical coherence tomography (OCT), elastography, Doppler OCT, and their clinical imaging applications in medical diagnostics.
CO 5	Explore advanced techniques like near-field imaging, fluorescent spectroscopy, and photodynamic therapy, with a focus on in vitro clinical diagnostics and biological structure imaging.

BM P71 – Digital Image Processing Lab	Yr/Sem: IV/VII

CO 1	Explore image sampling, quantization, intensity transformation, histogram processing,

	spatial and frequency domain filtering, DFT analysis, and edge detection using MATLAB or similar tools.
CO 2	Develop applications in biometrics, medical imaging, texture analysis, and boundary detection, showcasing practical implementations of image processing algorithms for real-world scenarios.

BM P72 – Seminar   **Yr/Sem: IV/VII**

CO 1	Students must be able to make critical review of literature.
CO 2	Preparation of report on the topic.

BM P73 – Industrial Visit/ Training   **Yr/Sem: IV/VII**

CO 1	Students must be able to undertake an industrial visit and training.
CO 2	Understand industrial culture and practical knowledge.

BM PW7 – Project Work Phase – I   **Yr/Sem: IV/VII**

CO 1	On completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.
CO 2	Formulate a real world problem in biomedical sector, identify the requirement and develop project.
CO 3	Identify technical ideas, strategies and methodologies to find solution to the proposed project.
CO 4	Utilize new tools and techniques that contribute to obtain solution to the project.
CO 5	Prepare report and present oral demonstrations.

VIII – SEMESTER

BM T81 – Professional Ethics Practice   **Yr/Sem: IV/VIII**

CO 1	Explore moral dilemmas in engineering, understanding various ethical theories and their practical applications in decision-making.
CO 2	Discuss engineering as an experimental practice and delve into the codes of ethics guiding engineers' professional conduct.
CO 3	Focus on the ethical obligation of engineers to prioritize safety in their designs, ensuring public welfare and minimizing potential risks.
CO 4	Examine the balance between engineers' professional responsibilities towards society and their individual rights, understanding the ethical implications.
CO 5	Address the global dimension of engineering ethics, considering cultural differences, international standards, and the ethical dilemmas arising in a diverse, interconnected world.

BM T82 – Hospital Safety and Management   **Yr/Sem: IV/VIII**

CO 1	Explore clinical engineers' roles, educational responsibilities, and staff structures in hospitals, including Health Information Systems (HIS).
CO 2	Address training methods, employee evaluation, salary structures, and appraisal techniques in hospital and industrial organizations.

CO 3	Emphasize healthcare standardization, regulatory bodies like FDA and AERB, and monitoring methods for accreditation organizations.
CO 4	Cover strategic management, IT applications, statistical tools, and support services including disaster management and safety protocols for various hospital functions.
CO 5	Focus on safety elements, standards, laboratory safety, radiation hazards, ergonomics, handling hazardous materials, and safety measures in hospital environments.

BM T83 – Biomechanics	**Yr/Sem: IV/VIII**
CO 1	Explore fundamental mechanics in medicine, including bone structure and biofluid properties.
CO 2	Study heart valves, soft tissue constitutive equations, and cardiovascular fluid dynamics.
CO 3	Understand cartilage and bone mechanics, joint kinetics, and lubrication processes.
CO 4	Learn mathematical modeling techniques, including Finite Element Analysis, for arterial dynamics.
CO 5	Apply biomechanics to gait analysis, joint reactions, and human locomotion dynamics.

BM E87 – Rehabilitation Engineering	**Yr/Sem: IV/VIII**
CO 1	Understand rehabilitation, preventive measures, disability diagnosis, and the diverse roles within the rehabilitation team.
CO 2	Explore human factors, assistive technology assessment, engineering and ergonomic principles in rehabilitation.
CO 3	Learn coordination exercises, gait analysis, relaxation methods, strengthening exercises, mobilization, and endurance exercises.
CO 4	Study communication impairments, types of aphasia, augmentative communication, visual aids, hearing aids, and writing aids.
CO 5	Delve into orthotic classifications, orthotic principles, and various prosthetic devices, including body-powered and myoelectric-controlled prosthetics.

BM P81 – Comprehensive Viva	**Yr/Sem: IV/VIII**
CO 1	Remember all areas of biomedical engineering.

BM PW8– Project Phase II	**Yr/Sem: IV/VIII**
CO 1	Practice of working harmoniously in a group.
CO 2	Create a project involving analytical, experimental, design combinations related to biomedical engineering.
CO 3	Prepare a report consisting of a literature survey, problem statement, methodology, results and conclusions.