DEPARTMENT OF BIOMEDICAL ENGINEERING

PROGRAMME: B.E. BIOMEDICAL ENGINEERING

VISION

- To be recognized as a leader in offering Biomedical Engineering education, research and application of knowledge to the society.

MISSION

- To equip the students with adequate knowledge in the field of Biomedical Engineering with exemplary values.
- To encourage entrepreneurship and mould the students to learn new technologies in healthcare Industry.
- To foster research and development in Biomedical Engineering.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- To enable the graduates to demonstrate their skills in design and develop medical devices for health care system through the core foundation and knowledge acquired in engineering and biology.
- To enable the graduates to exhibit leadership in health care team to solve health care problems and make decisions with societal and ethical responsibilities.
- To Carryout multidisciplinary research, addressing human healthcare problems and sustain technical competence with ethics, safety and standards.
- To ensure that graduates will recognize the need for sustaining and expanding their technical competence and engage in learning opportunities throughout their careers.

PROGRAM OUTCOMES (POs)

- Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- Problem analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

- Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

- To design and develop diagnostic and therapeutic devices that reduces physician burnout

Engineering.

- To apply software skills in developing algorithms for solving healthcare related problems in various fields of Medical sector.
- To adapt to emerging information and communication technologies (ICT) to innovate ideas and solutions for current societal and scientific issues thereby developing indigenous medical instruments that are on par with the existing technology.

COURSE OUTCOMES (COs)

Regulation	2017
Sem	01
Subject Code	HS8151
Subject Name	COMMUNICATIVE ENGLISH
Course Outcome	• Read articles of a general kind in magazines and newspapers. • Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English. • Comprehend conversations and short talks delivered in English. • Write short essays of a general kind and personal letters and emails in English.

Regulation	2017
Sem	01
Subject Code	MA8151
Subject Name	ENGINEERING MATHEMATICS – I
Course Outcome	• Use both the limit definition and rules of differentiation to differentiate functions. • Apply differentiation to solve maxima and minima problems

	• Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus. • Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables. • Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts. • Determine convergence/divergence of improper integrals and evaluate convergent improper integrals. • Apply various techniques in solving differential equations.

Regulation	2017
Sem	01
Subject Code	PH8151
Subject Name	ENGINEERING PHYSICS
Course Outcome	• The students will gain knowledge on the basics of properties of matter and its applications. • The students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics. • The students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers. • The students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes. • The students will understand the basics of crystals, their structures and different crystal growth techniques.

Regulation	2017
Sem	01

Subject Code	CY8151
Subject Name	ENGINEERING CHEMISTRY
Course Outcome	• The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

Regulation	2017
Sem	01
Subject Code	GE8151
Subject Name	PROBLEM SOLVING AND PYTHON PROGRAMMING
Course Outcome	• Develop algorithmic solutions to simple computational problems. • Read, write, execute by hand simple Python programs. • Structure simple Python programs for solving problems. • Decompose a Python program into functions. • Represent compound data using Python lists, tuples, and dictionaries. • Read and write data from/to files in Python Programs.

Regulation	2017
Sem	01
Subject Code	GE8152
Subject Name	ENGINEERING GRAPHICS
Course Outcome	• Familiarize with the fundamentals and standards of engineering graphics. • Perform freehand sketching of basic geometrical constructions and multiple views of objects. • Project orthographic projections of lines and plane surfaces. • Draw projections and solids and development of surfaces.

	simple solids.

Regulation	2017
Sem	01
Subject Code	GE8161
Subject Name	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY
Course Outcome	• Write, test and debug simple Python programs. • Implement Python programs with conditionals and loops. • Develop Python programs step-wise by defining functions and calling them. • Use Python lists, tuples, dictionaries for representing compound data.. • Read and write data from/to files in Python programs.

Regulation	2017
Sem	01
Subject Code	BS8161
Subject Name	PHYSICS AND CHEMISTRY LABORATORY
Course Outcome	• Apply principles of elasticity, optics and thermal properties for engineering applications. • The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

Regulation	2017
Sem	02
Subject Code	HS8251
Subject Name	TECHNICAL ENGLISH
Course Outcome	• Read technical texts and write area- specific texts effortlessly. • Listen and comprehend lectures and talks in their area of

	• Speak appropriately and effectively in varied formal and informal contexts. • Write reports and winning job applications.

Regulation	2017
Sem	02
Subject Code	MA8251
Subject Name	ENGINEERING MATHEMATICS – II
Course Outcome	• Eigen values and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices. • Gradient, divergence and curl of a vector point function and related identities. • Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification. • Analytic functions, conformal mapping and complex integration. • Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

Regulation	2017
Sem	02
Subject Code	PH8253
Subject Name	PHYSICS FOR ELECTRONICS ENGINEERING
Course Outcome	• Gain knowledge on classical and quantum electron theories and energy band structures. • Acquire knowledge on basis of semiconductor physics and its applications in various devices. • Get knowledge on magnetic and dielectric properties of

	• Have the necessary understanding on the functioning of optical materials for optoelectronics. • Understand the basics of quantum structures and their applications in spintronics and carbon electronics.

Regulation	2017
Sem	02
Subject Code	BM8251
Subject Name	ENGINEERING MECHANICS FOR BIOMEDICAL ENGINEERS
Course Outcome	• Use scalar and vector analytical techniques for analyzing forces in statically determinate structures. • Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.

Regulation	2017
Sem	02
Subject Code	BM8201
Subject Name	FUNDAMENTALS OF BIO CHEMISTRY
Course Outcome	• Explain the fundamentals of biochemistry • Clinical application of Biochemistry

Regulation	2017
Sem	02
Subject Code	EC8251
Subject Name	CIRCUIT ANALYSIS
Course Outcome	• Develop the capacity to analyze electrical circuits, apply the circuit theorems in real time

Regulation	2017
Sem	02
Subject Code	GE8261
Subject Name	ENGINEERING PRACTICES LABORATORY
Course Outcome	• Fabricate carpentry components and pipe connections including plumbing works. • Use welding equipments to join the structures. • Carry out the basic machining operations. • Make the models using sheet metal works. • Illustrate on centrifugal pump, air conditioner, operations of smithy, foundary and fittings. • Carry out basic home electrical works and appliances. • Measure the electrical quantities. • Elaborate on the components, gates, soldering practices.

Regulation	2017
Sem	02
Subject Code	BM8211
Subject Name	BIOCHEMISTRY LABORATORY
Course Outcome	• Understand the biochemistry laboratory functional components • Understand the basics principle of preparation of buffers

Regulation	2017
Sem	03
Sub Code	MA8352
Sub Name	LINEAR ALGEBRA AND PARTIAL DIFFERENTIAL EQUATIONS

Course Outcome	• Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts. • Demonstrate accurate and efficient use of advanced algebraic techniques. • Demonstrate their mastery by solving non - trivial problems related to the concepts and by proving simple theorems about the statements proven by the text. • Able to solve various types of partial differential equations. • Able to solve engineering problems using Fourier series

Regulation	2017
Sem	03
Sub Code	EC8352
Sub Name	SIGNALS AND SYSTEMS
Course Outcome	• To be able to determine if a given system is linear/causal/stable • Capable of determining the frequency components present in a deterministic signal • Capable of characterizing LTI systems in the time domain and frequency domain • To be able to compute the output of an LTI system in the time and frequency domains

Regulation	2017
Sem	03
Sub Code	BM8351
Sub Name	ANATOMY AND HUMAN PHYSIOLOGY

Course Outcome	• Students would be able to explain basic structure and functions of cell • Students would be learnt about anatomy and physiology of various systems of human body • Students would be able to explain interconnect of various systems

Regulation	2017
Sem	03
Sub Code	BM8301
Sub Name	SENSORS AND MEASUREMENTS
Course Outcome	• Measure various electrical parameters with accuracy, precision, resolution. • Select appropriate passive or active transducers for measurement of physical phenomenon. • Select appropriate light sensors for measurement of physical phenomenon. • Use AC and DC bridges for relevant parameter measurement. • Employ Multimeter, CRO and different types of recorders for appropriate measurement

Regulation	2017
Sem	03

Sub Name	ELECTRON DEVICES AND CIRCUITS
Course Outcome	• Explain the structure and working operation of basic electronic devices. • Able to identify and differentiate both active and passive elements • Analyze the characteristics of different electronic devices such as diodes and transistors Choose and adapt the required components to construct an amplifier circuit. • Employ the acquired knowledge in design and analysis of oscillators

Regulation	2017
Sem	03
Sub Code	BM8302
Sub Name	PATHOLOGY AND MICROBIOLOGY
Course Outcome	• Analyze structural and functional aspects of living organisms. • Explain the function of microscope • Discuss the importance of public health. • Describe methods involved in treating the pathological diseases.

Regulation	2017
Sem	03
Sub Code	BM8311
Sub Name	PATHOLOGY AND MICROBIOLOGY LABORATORY

Course Outcome	• Student can perform practical experiments on tissue processing, cryoprocessing, staining Processes etc.

Regulation	2017
Sem	03
Sub Code	BM8312
Sub Name	DEVICES AND CIRCUITS LABORATORY
Course Outcome	• Analyze the characteristics of basic electronic devices Design RL and RC circuits • Verify Thevinin & Norton theorem KVL & KCL, and Super Position Theorems

Regulation	2017
Sem	03
Sub Code	BM8313
Sub Name	HUMAN PHYSIOLOGY LABORATORY
Course Outcome	• Identification and enumeration of blood cells Enumeration of hematological parameters • Analysis of special sensory organs test

Regulation	2017

Sub Code	MA8391
Sub Name	PROBABILITY AND STATISTICS
Course Outcome	• Understand the fundamental knowledge of the concepts of probability and have knowledgeof standard distributions which can describe real life phenomenon. • Understand the basic concepts of one and two dimensional random variables and apply in engineering applications. • Apply the concept of testing of hypothesis for small and large samples in real life problems. • Apply the basic concepts of classifications of design of experiments in the field ofagriculture and statistical quality control. • Have the notion of sampling distributions and statistical techniques used in engineeringand management problems.

Regulation	2017
Sem	04
Sub Code	BM8401
Sub Name	MEDICAL PHYSICS
Course Outcome	• Explain about non-ionizing radiation, interaction with tissue and its effects. • Define and compare intensities of sensory stimuli • Summarizes how ionizing radiation interacts with the human body, how to quantify it and itslevels seen in the environment and healthcare • Explain the fundamentals of radioactivity and radioactive isotopes • Illustrates the methods of detecting and recording the ionizing radiation and its interaction withmatter

Sem	04
Sub Code	EE8452
Sub Name	BASICS OF ELECTRICAL ENGINEERING
Course Outcome	• Design simple electrical circuits and understand through nodal, mesh analysis aboutconstructing series and parallel configuration of circuits with sources and variable loads. • Get knowledge on electrical machines and on its efficient operating principle. • Understand metering principles, safety measures while working with electrical circuits. • Analyze existing power distribution and hence apply technology in electrical applications .

Regulation	2017
Sem	04
Sub Code	EC8453
Sub Name	LINEAR INTEGRATED CIRCUITS
Course Outcome	• Design linear and non linear applications of OP – AMPS • Design applications using analog multiplier and PLL • Design ADC and DAC using OP – AMPS • Generate waveforms using OP – AMP Circuits • Analyze special function ICs

Regulation	2017
Sem	04
Sub Code	EC8393
Sub Name	FUNDAMENTALS OF DATA STRUCTURES IN C

Course Outcome	• Implement linear and non-linear data structure operations using C • Suggest appropriate linear / non-linear data structure for any given data set. • Apply hashing concepts for a given problem • Modify or suggest new data structure for an application • Appropriately choose the sorting algorithm for an application

Regulation	2017
Sem	04
Sub Code	EC8392
Sub Name	DIGITAL ELECTRONICS
Course Outcome	• Use digital electronics in the present contemporary world • Design various combinational digital circuits using logic gates • Do the analysis and design procedures for synchronous and asynchronous sequentialcircuits • Use the semiconductor memories and related technology • Use electronic circuits involved in the design of logic gates

Regulation	2017
Sem	04
Sub Code	EC8381
Sub Name	FUNDAMENTALS OF DATA STRUCTURES IN C LABORATORY
Course Outcome	• Write basic and advanced programs in C • Implement functions and recursive functions in C • Implement data structures using C • Choose appropriate sorting algorithm for an application and implement it in a modularizedway

Regulation	2017
Sem	04
Sub Code	BM8411
Sub Name	INTEGRATED CIRCUITS LABORATORY
Course Outcome	• Design oscillators and amplifiers using operational amplifiers. • Design filters using Opamp and perform experiment on frequency response. • Analyse the working of PLL and use PLL as frequency multiplier. • Design DC power supply using ICs. • Aquire knowledge in using SPICE

Regulation	2017
Sem	05
Sub Code	EC8394
Sub Name	ANALOG AND DIGITAL COMMUNICATION
Course Outcome	• Apply analog and digital communication techniques. • Use data and pulse communication techniques. • Analyze Source and Error control coding. • Utilize multi-user radio communication.

Regulation	2017
Sem	05
Sub Code	BM8501
Sub Name	BIOCONTROL SYSTEMS

Course Outcome	• Understand the need for mathematical modeling of various systems, representation of systems in block diagrams and signal flow graphs and are introduced to biological control systems • Analyze the time response of various systems and discuss the concept of system stability • Analyze the frequency response characteristics of various systems using different charts • Understand the concept of modeling basic physiological systems • Comprehend the application aspects of time and frequency response analysis inphysiological control systems.

Regulation	2017
Sem	05
Sub Code	BM8502
Sub Name	BIOMEDICAL INSTRUMENTATION
Course Outcome	• Differentiate different bio potentials and its propagations. • Illustrate different electrode placement for various physiological recordings • Design bio amplifier for various physiological recordings • Explain various technique for non-electrical physiogical measurements • Demonstrate different biochemical measurement techniques.

Regulation	2017
Sem	05
Sub Code	EC8553
Sub Name	DISCRETE-TIME SIGNAL PROCESSING

Course Outcome	• Apply DFT for the analysis of digital signals and systems • Design IIR and FIR filters • Characterize the effects of finite precision representation on digital filters • Design multi rate filters • Apply adaptive filters appropriately in communication systems

Regulation	2017	
Sem	05	
Sub Code	EC8562	PROFESSIONAL ELECTIVE
Sub Name	BIOMATERIALS	
Course Outcome	• Carryout basic signal processing operations • Demonstrate their abilities towards MATLAB based implementation of various DSPsystems • Analyze the architecture of a DSP Processor • Design and Implement the FIR and IIR Filters in DSP Processor for performing filtering operation over real-time signals • Design a DSP system for various applications of DSP	

Regulation	2017	
Sem	05	OPEN ELECTIVE
Sub Code	EC8562	
Sub Name	RENEWABLE ENERGY SOURCES	

Course Outcome	• Carryout basic signal processing operations • Demonstrate their abilities towards MATLAB based implementation of various DSPsystems • Analyze the architecture of a DSP Processor • Design and Implement the FIR and IIR Filters in DSP Processor for performing filtering operation over real-time signals • Design a DSP system for various applications of DSP

Regulation	2017
Sem	05
Sub Code	EC8562
Sub Name	DIGITAL SIGNAL PROCESSING LABORATORY
Course Outcome	• Carryout basic signal processing operations • Demonstrate their abilities towards MATLAB based implementation of various DSPsystems • Analyze the architecture of a DSP Processor • Design and Implement the FIR and IIR Filters in DSP Processor for performing filtering operation over real-time signals • Design a DSP system for various applications of DSP

Regulation	2017
Sem	05
Sub Code	BM8511
Sub Name	BIO MEDICAL INSTRUMENTATION LABORATORY

Course Outcome	• Design preamplifiers and amplifiers for various bio signal recordings. • Measure various non-electrical parameters using suitable sensors/transducers • Design PCB layout for any bio amplifier

Regulation	2017
Sem	05
Sub Code	HS8381
Sub Name	INTERPERSONAL SKILLS/LISTENING&SPEAKING
Course Outcome	• Listen and respond appropriately. • Participate in group discussions • Make effective presentations • Participate confidently and appropriately in conversations both formal and informal

Regulation	2017
Sem	06
Sub Code	EC8691
Sub Name	MICROPROCESSORS AND MICROCONTROLLERS
Course Outcome	• Understand and execute programs based on 8086 microprocessor. • Design Memory Interfacing circuits. • Design and interface I/O circuits. • Design and implement 8051 microcontroller based systems

Sem	06
Sub Code	BM8601
Sub Name	DIAGNOSTIC AND THERAPEUTIC EQUIPMENT- I
Course Outcome	• Describe the working and recording setup of all basic cardiac equipment. • Understand the working and recording of all basic neurological equipment's. • Discuss the recording of diagnostic and therapeutic equipment's related to EMG. • Explain about measurements of parameters related to respiratory system. • Describe the measurement techniques of sensory responses.

Regulation	2017
Sem	06
Sub Code	BM8651
Sub Name	BIOMECHANICS
Course Outcome	• Understand the principles of mechanics • Outline the principles of biofluid dynamics. • Explain the fundamentals of bio-solid mechanics. • Apply the knowledge of joint mechanics. • Give Examples of computational mathematical modelling applied in biomechanics

Regulation	2017

Sub Code	GE8291
Sub Name	ENVIRONMENTAL SCIENCE AND ENGINEERING
Course Outcome	• Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course. • Public awareness of environmental is at infant stage. • Ignorance and incomplete knowledge has lead to misconceptions • Development and improvement in std. of living has lead to serious environmental disasters

Regulation	2017
Sem	06
Sub Code	MD8091
Sub Name	HOSPITAL MANAGEMENT
Course Outcome	• Explain the principles of Hospital administration. • Identify the importance of Human resource management. • List various marketing research techniques. • Identify Information management systems and its uses. • Understand safety procedures followed in hospitals.

Regulation	2017
Sem	06
Sub Code	EC8681
Sub Name	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

Course Outcome	• Write ALP Programmes for fixed and Floating Point and Arithmetic operations • Interface different I/Os with processor • Generate waveforms using Microprocessors • Execute Programs in 8051 • Explain the difference between simulator and Emulator

Regulation	2017
Sem	06
Sub Code	BM8611
Sub Name	DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LABORATORY
Course Outcome	• Measure different bioelectrical signals using various methods • Assess different non-electrical parameters using various methodologies • Illustrate various diagnostic and therapeutic techniques • Examine the electrical safety measurements • Analyze the different bio signals using suitable tools.

Regulation	2017
Sem	06
Sub Code	BM8612
Sub Name	MINI PROJECT
Course Outcome	• Formulate a real world problem, identify the requirement and develop the design solutions. • Express the technical ideas, strategies and methodologies. • Utilize the new tools, algorithms, techniques that contribute to obtain the solution of theproject. • Test and validate through conformance of the developed prototype and analysis the cost effectiveness. • Prepare report and present the oral demonstrations.

Regulation	2017
Sem	06
Sub Code	HS8581
Sub Name	PROFESSIONAL COMMUNICATION
Course Outcome	• Make effective presentations • Participate confidently in Group Discussions. • Attend job interviews and be successful in them. • Develop adequate Soft Skills required for the workplace

Regulation	2017
Sem	07
Sub Code	BM8701
Sub Name	DIAGNOSTIC AND THERAPEUTIC EQUIPMENT – II
Course Outcome	• Discuss the various equipment used in ICU and applications of telemetry. • Explain the types of diathermy and its applications. • Express the basics of ultrasound and its application in medicine • Discuss the various extracorporeal and special diagnostic devices used in hospitals • Outline the importance of patient safety against electrical hazard

Regulation	2017
Sem	07

Sub Code	EC8093
Sub Name	DIGITAL IMAGE PROCESSING
Course Outcome	• Know and understand the basics and fundamentals of digital image processing, such asdigitization, sampling, quantization, and 2D-transforms. • Operate on images using the techniques of smoothing, sharpening and enhancement. • Understand the restoration concepts and filtering techniques. • Learn the basics of segmentation, features extraction, compression and recognitionmethods for color models.

Regulation	2017
Sem	07
Sub Code	BM8703
Sub Name	REHABILITATION ENGINEERING
Course Outcome	• Gain adequate knowledge about the needs of rehabilitations and its future development. • Have an in depth idea about Engineering Concepts in Sensory & Motor rehabilitation. Apply the different types of Therapeutic Exercise Technique to benefit the society. • Design and apply different types Hearing aids, visual aids and their application inbiomedical field and hence the benefit of the society. • Gain in-depth knowledge about different types of models of Hand and arm replacement.

Regulation	2017
Sem	07
Sub Code	EC8762

Course Outcome	• Perform enhancing operations on the image using spatial filters and frequency domain filters. • Use transforms and analyzes the characteristics of the image. • Perform segmentation operations in the images. • Estimate the efficiency of the compression technique on the images. • Apply image processing technique to solve real health care problems.

Regulation	2017
Sem	07
Sub Code	MD8751
Sub Name	HOSPITAL TRAINING
Course Outcome	• Advocate a patient-centered approach in healthcare • Communicate with other health professionals in a respectful and responsible manner • Recognize the importance of inter-professional collaboration in healthcare. • Propose a patient-centered inter-professional health improvement plan based upon the patient's perceived needs • Use the knowledge of one's own role and those of other professions to address the healthcare needs of populations and patients served.

Regulation	2017
Sem	08
Sub Code	BM8811
Sub Name	PROJECT WORK

Course Outcome	• 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.