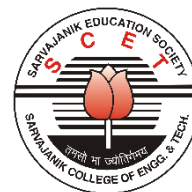




SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology



B. Tech. Semester VI

Subject Name: Biomedical Electronics

Subject Code: BTEC15602

Type of course: OE

Prerequisite: Basic electronics

Rationale: This course is designed to educate the students with the technological innovations of many applications in the field of Biomedical Electronics. The biomedical parameters like ECG, EEG, EMG, etc. are vital signs considered for preliminary diagnostic tools for patient health conditions. It describes the principles, applications, and design process of the medical instruments used for such measurement. It covers the topics from the origin of bio-potential, through electrodes, to the special amplifier design requirement and electric safety in hospitals. It is designed to provide an understanding of Biomedical Applications of Electronics. It is also designed to develop the practical skills necessary to build biomedical applications of electronics.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	100
3	0	0	3	60	25	15	-	-	

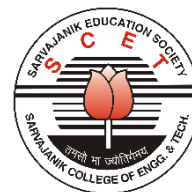
CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests) **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. no.	Topics	Teaching Hrs.	Module % Weightage
1.	Introduction to Biomedical Electronics: Introduction to Biomedical Electronics, Evolution in Biomedical instrumentation and electronics, Introduction to Man – Instrument Systems, Components of Man – Instrument Systems, Major System of Human Body, Physiological Systems of Human Body.	3	5
2.	Fundamentals of Medical Electronics: Medical Electronic Systems, Operational Modes, Electronics Measurements and challenges, Classification of Bio Medical Electronic Systems, Interfering and modifying inputs, comparison techniques, Design criteria, commercial medical electronic system development process.	3	5
3.	Bio Signal Processing and Measurement Errors: Fundamental of Noise source and its types, SNR, Noise Factor, figure of merits, temperature effect, Noise in Cascade Amplifier,	5	10



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	Noise Reduction Strategies, error sources, Tactics and signals processing for improved sensing, Bioelectric amplifiers, sensors and interfacing circuits for Bioelectric amplifiers.		
4.	Sources of Bioelectric Potentials of excitable cells: Active and Resting state potentials, Network equivalent circuit of nerve/skeletal fiber, Propagation of action potential, volume conductor fibers.	4	10
5.	Fundamentals of Bio-Potential Electrodes Theory: Electrode theory, the electrode –electrolyte interface, Polarizable and nonpolarizable electrodes, circuit models for electrodes, electrode for body skin and motions, Body-surface recording electrodes, Microelectrodes, Electrode Arrays.	6	15
6.	The cardiovascular system and Electrocardiography Anatomy: The heart and Cardiovascular system, Blood Pressure, Characteristics of Blood flow, electro-conduction system of heart, The ECG waveform, ECG Noises, ECG amplification and signal conditioning circuits, ECG readout devices, ECG Machines, ECG faults and Troubleshooting.	6	15
7.	The Human Nervous System and Brain function Measurement: Organization of the nervous system, the neuron, Brain function measurement Cerebral angiography, Cranial X-rays, brain scans, ultrasonic equipment Electroencephalography: Neuron membrane potentials, EEG Electrodes and the 1-20 systems, EEG amplitude and frequency bands, EEG diagnostic uses and sleep patterns, EEG System Block Diagram, Preamplifier, EEG telemetry.	8	20
8.	Bio Medical Equipment: EMG, Pacemaker, Defibrillator, Heart Lung Machine, Dialysis, Diathermy Unit for Surgery and therapy, LASER in Surgery, Robotic Surgical Equipments, Invasive Medical Procedures	6	10
9.	Medical Imaging: Principle of Radiation, Components of X-ray System, Principle of CT SCAN, USG, MRI, PET Scan.	4	10

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	15	20	20	15	20

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels (**Revised Bloom’s Taxonomy**)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.



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Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1	Introduction to Biomedical Equipment Technology	Joseph J. Carr, John M. Brown	Pearson 9780130104922	2020	4 th
2	Medical Instrumentation Application & Design	John G. Webster	John Wiley & 9780471676003	2009	4 th
3	Handbook of Biomedical Instrumentation	R.S.Khandpur	McGraw Hill 9789339205430	2014	3 rd
4	Biomedical Instrumentation	M. Arumugam	Anuradha 9788187721123	2017	1 st
5	Biomedical Digital Signal Processing	Willis J.	Prentice 9788120314788	2007	1 st
6	Signals and Systems in Biomedical Engineering	Suresh R. Devashahayan	Kluwer 9781461453321	2013	2 nd

Course Outcome:

Sr. No.	CO Statement After learning this subject students will be able to	Marks % weightage
CO-1	Apply the knowledge of electronic devices and theory of operation in the medical area.	20
CO-2	Design circuits and analyze the performance to solve the problems related to biomedical signals like ECG, EEG etc.	20
CO-3	Design electronic circuits for medical applications	20
CO-4	Solve problems that arise with complex medical equipment.	20
CO-5	Apply the concept of op-amp based amplifier for medical instruments	20

Mapping with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	3	-	-	-	-	2	2	1	-	-	2	2
CO-2	3	2	2	2	3	2	2	2	-	-	2	2
CO-3	3	2	2	2	3	2	2	2	-	-	2	2
CO-4	3	2	2	2	3	2	2	2	-	-	2	2
CO-5	3	-	-	-	-	2	2	1	-	-	2	2