GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3151710
Semester – V
Subject Name: Biomedical Instrumentation

Type of course: Open Elective

Prerequisite: Knowledge of sensor/ transducers, op-amp based circuit, simulation know- how on MatLAB or other software

Rationale: The biomedical parameters like ECG, EEG, EMG, etc. are vital signs considered for preliminary diagnostic tools for patient health condition. This course describes the principles, applications, and design process of the medical instruments used for such measurement. The course covers the topic from the origin of bio-potential, through electrodes, to the special amplifier design requirement and electric safety in hospitals.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	2	3	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**The Human Body: An Overview** Cell structure, Body fluids, Major systems of the body	2
2	**Basic concepts of Medical Instrumentation** Generalized medical instrumentation system, operational modes, medical measurement constraints, classification of biomedical instruments.	2
3	**The Origin of Bio-potential** Electrical activity of excitable cells- Resting states, Nernst equation, G-H-K equation, Active states, Network equivalent circuit of nerve/ skeletal fiber, propagation of action potential Volume conductor fields	4
4	**Bio-potential Electrodes** The electrode-electrolyte interface, Polarization, Polarizable and nonpolarizable electrodes, Electrode behaviour and circuit models, The electrode skin interface and Motion artifact, Body-surface recording electrodes, Internal electrodes, Electrode arrays, Microelectrodes, Electrodes for electric stimulation of tissue	4

5	**Electrocardiography** Electro-conduction system of the heart, The ECG waveform &Wigger's diagram, Heart problems The standard lead system, other ECG signals, ECG Noises, ECG amplification and signal conditioning circuits, ECG readout devices	**4**
6	**The Human nervous system & Brain function measurement** Anatomy & physiology of nervous system **Instrumentation for brain function measurement** Cerebral angiography, cranial x-rays, brain scans, ultrasonic equipment **Electroencephalography:** Neuron membrane potentials, EEG electrodes and the 1-20 system, EEG amplitude and frequency bands, EEG diagnostic uses and sleep patterns, EEG system block diagram, Preamplifiers and EEG system specifications, Visual and auditory evoked potential recordings, EEG telemetry	**4**
7	**Electrical Safety** Physiological effects of electricity, Important susceptibility parameters, distribution of electric power, Macroshock hazards, Microshock hazards, Electrical- Safety codes and standards	**4**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
14	**21**	**14**	**14**	**14**	**7**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and 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.

Reference Books:

1. Introduction to Biomedical Equipment Technology by Josheph J. Carr and John M. Brown, Pearson Education
2. Medical Instrumentation- Application and Design by John. G. Webster, John Wiley & Sons,
3. Biomedical Digital Signal Processing by Willis J. Tompkins, Prentice-Hall of India
4. Biomedical Signal analysis- A Case Study Approach by Rangraj M. Rangayyan, Wiley India,
5. Signals and Systems in Biomedical Engineering by Suresh R. Devashahayan, Kluwer academics/ Plenum publication

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Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Characterize anatomy and physiology of important physiological system of human body.	15
CO-2	Analyze and design of medical instruments by evaluating medical parameter measurement constraint.	25
CO-3	Analyze various types of bio-potential electrodes, machines and its application	20
CO-4	Analyze important vital sign parameters to evaluate certain disease conditions.	25
CO-5	Develop habit of following electrical safety rules and regulations while using Biomedical Instruments	15