



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code : 3171721

Subject Name : Biomedical Instrumentation

WEF Academic Year :	2022-23
Semester :	7
Category of the Course :	Professional Elective V

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.

Course Scheme :

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Practical		
				ESE (E)	PA(M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Course Content :

Sr. No.	Course Content	No. of Hours	% of Weightage
1	The Human Body: An Overview Cell structure, Body fluids, Major systems of the body	3	7
2	Basic concepts of Medical Instrumentation Generalized medical instrumentation system, operational modes, medical measurement constraints, classification of biomedical instruments.	5	11
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	5	11
4	Bio-potential Electrodes	8	18



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	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		
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	10	22
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	10	22
7	Electrical Safety Physiological effects of electricity, Important susceptibility parameters, distribution of electric power, Macroshock hazards, Microshock hazards, Electrical- Safety codes and standards	4	9
Total		45	100

Reference Book :

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

Course Outcome :

After Completion of the Course, Student will able to :

No	Course Outcomes	RBT Level*
01	Characterize anatomy and physiology of important physiological system of human body.	RM
02	Analyze and design of medical instruments by evaluating medical	UN



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	parameter measurement constraint.	
03	Analyze various types of bio-potential electrodes, machines and its application	AP
04	Analyze important vital sign parameters to evaluate certain disease conditions.	AN
05	Develop habit of following electrical safety rules and regulations while using Biomedical Instruments	AN

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Suggested Course Practical List :

1. To study physiological systems of human body
2. To implement a Biopotential Amplifier.
3. To study and simulate Electrocardiograph (ECG)
4. To study and simulate Electroencephalography (EEG)
5. To measure heart rate using a heart rate or pulse measuring device.
6. To simulate defibrillator
7. To simulate pacemaker
8. To identify different types of biopotential electrodes.
9. To study different electrical safety codes and standards for medical equipments
10. To prepare a report on any biomedical instrument.
11. Case Study / Mini Projects

List of Laboratory/Learning Resources Required :

1. Common Lab Manual (DTE)
2. Virtual Laboratory (vLab.co.in)
3. NPTEL Website

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