



**C. U. SHAH UNIVERSITY**  
**Wadhwan City**

**FACULTY OF:** - Technology & Engineering

**DEPARTMENT OF:** -Instrumentation & Control Engineering

**SEMESTER:** - VII

**CODE:** - 4TE07BMI1

**NAME** – Biomedical Instrumentation

**Teaching & Evaluation Scheme**

Subject Code	Subject Name	Teaching Hours/Week				Credits	Evaluation Scheme/Semester							
		Th	Tu	Pr	Total		Theory				Practical			Total Marks
							Sessional Exam		University Exam		Internal		University	
							Marks	Hrs	Marks	Hrs	Pr/Viva	TW	Pr	
4TE07BMI1	Biomedical Instrumentation	3	0	2	5	4	30	1.5	70	3	--	20	30	150

**OBJECTIVES**

- To acquaint the students with fundamentals of Biomedical Engineering and related Instrumentation.

**PRE-REQUISITES**

- Fundamentals of electronics, measurement & instrumentation.

**COURSE OUTLINES**

Sr. No.	Course Contents	No. of Hours
1.	<b>The Human Body: An Overview</b> Cell structure, Body fluids, Major systems of the body: , Musculoskeletal system, Respiratory system, Gastrointestinal system, Nervous system, Endocrine system, The circulatory system, The body as a control system	8
2.	<b>Basic concepts of Medical Instrumentation</b> Generalized medical instrumentation system, operational modes, medical measurement constraints, classification of biomedical instruments, interfering and modifying inputs, compensation techniques, Design criteria, commercial medical instrumentation development process	3
3.	<b>Fundamentals for bio-signal processing</b> <b>Measurement errors</b> - Types & analysis <b>Noise</b> - Types, SNR, Noise factor, figure and temperature, Noise in cascade amplifiers, Noise reduction strategies <b>Sensor</b> - Types, error sources, Tactics and signals processing for improved sensing, Matching sensors to circuit <b>Bioelectric Amplifiers</b> - Op-amp ideal properties, Instrumentation amplifiers, Isolation amplifiers, Chopper stabilized amplifiers, Input guarding	5

4.	<b>Bio Potentials and Biopotential Electrodes:</b> <b>Origin of Bio potentials :</b> Electrical activity of excitable cells- Resting states, Active states, Network equivalent circuit of nerve/ skeletal fiber, propagation of action potential <b>Biopotential Electrodes:</b> The electrode-electrolyte interface, Polarization, Polarisable and non polarisable 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	8
5.	<b>Electrocardiography</b> Anatomy & physiology of heart, electro-conduction system of the heart, The heart as a potential source, The ECG waveform, The standard lead system, Other ECG signals, ECG machine, ECG machine maintenance, ECG faults and troubleshooting	5
6.	<b>The Human nervous system &amp; Brain function measurement</b> Organization of the nervous system, the neuron, structure and function of the central nervous system, Peripheral nervous system, Autonomic nervous system <b>Instrumentation for brain function measurement</b> Cerebral angiography, cranial x-rays, brain scans, ultrasonic equipment Electroencephalography: Neuron membrane potentials, EEG electrodes and the 10/20 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, Typical EEG system artifacts, faults, troubleshooting, and maintenance	5
7	<b>Medical Ultrasonography:</b> Introduction, Physics of sound and ultrasound waves, Ultrasound transducers, Absorption and attenuation of ultrasound energy, Scan modes and scanning systems, Biological effects of ultrasound, Doppler effect, Transcutaneous Doppler flow detectors, Flow meters, Ultrasonic blood pressure measurement, Echoencephalography	5
8	<b>Physiological Pressure and Other Cardiovascular Measurement and Devices</b> Physiological pressures, defining pressure, pressure measurement, blood pressure measurement, Oscillometric and Ultrasonic Non-invasive pressure measurement, Direct method: H <sub>2</sub> O measurement, Pressure transducers, Pressure amplifiers, Calibration methods, Pressure amplifier design, AC carrier amplifiers, Systolic – diastolic and mean detector circuit, Pressure differentiation circuits, Automatic zero circuits, Practical problems in pressure monitoring, Step – function frequency response test, transducer care, cardiac output measurement, Dilution methods, Right-side heart pressure, Plethysmography, Blood flow measurement, Phonocardiography, Vectorcardiography, Catheterization laboratories, Defibrillators, Defibrillator circuits, Cardio version, Testing defibrillators, Pacemakers, Hear-Lung machine	3

### Learning Outcomes :

- Students will be able to understand the functioning and maintenance of basic instruments used for Biomedical Applications which will be helpful in future if they pursue a career in Biomedical Engineering.

### Books Recommended

- Introduction to Biomedical Equipment Technology by Joseph J. Carr and John M. Brown, Pearson Publication
- Handbook of Biomedical Instrumentation by R. S. Khandpur, Tata – McGraw Hill Publication