4EL51: BIOMEDICAL INSTRUMENTATION
CREDITS - 4 (LTP:3,0,1)

Course Objective:

1. The main objective of this course is to introduce student to basic biomedical engineering technology. As a result student can understand, design and evaluate systems and devices that can measure, test and/or acquire biological information from the human body.
2. To goal of this course is to learn the various systems of the human physiology, signals of biological origin obtained from these systems,
3. To understand the Electrical safety of medical devices, biosensors, transducers, bio electrodes used to acquire such signals, and amplifiers for measuring bio potentials.
4. To learn the measurements of the blood pressure, blood flow, EEG, ECG will also be discussed.

Teaching and Assessment Scheme:

Teaching Scheme (Hours Per Week)			Credits	Assessment Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topics	Teaching Hours
1.	**The Human Body :** Overview Cell Structure, Body Fluids, Major Systems of the Body	02
2.	**Basic concepts of Medical Instrumentation:** Generalized Medical Instrumentation System, Alternative Operational Modes, Medical Measurement Constraints, Classification Of Biomedical Instruments, Design Criteria, Commercial Medical Instrumentation Development Process	03
3.	**Fundamentals for bio-signal processing Measurement errors:** Types & Analysis Noise - Types, SNR, Noise Factor, Figure and Temperature, Noise in Cascade Amplifiers, Noise Reduction Strategies Sensor - Types, Error Sources, Tactics and Signals Processing for Improved Sensing, Matching Sensors to Circuit, Bioelectric Amplifiers.	05
4.	**The Origin of Bio-potential Electrical activity of excitable cells:** Resting states, Active states, Network equivalent circuit of nerve/ skeletal fiber, propagation of action potential.	04

Unit No.	Topics	Teaching Hours
5.	**Bio-potential Electrodes:** The Electrode-Electrolyte Interface, Polarization, Polarizable and Nonpolarizable Electrodes, Electrode Behavior and Circuit Models, The Electrode Skin Interface and Motion Artifact, Body-Surface Recording Electrodes, Internal Electrodes, Electrode Arrays, Microelectrodes.	07
6.	**Electrocardiography Anatomy & physiology of heart:** Electro-Conduction System of the Heart, The ECG Waveform. The Standard Lead System, ECG Noises, ECG Amplification and Signal Conditioning Circuits, ECG Readout Devices, ECG machines and maintenance of it, ECG faults & troubleshooting, Blood Pressure, characteristics of blood flow, Heart Sound	07
7.	**The Human nervous system & Brain function measurement:** Organization of the Nervous System, the Neuron, Instrumentation for Brain Function Measurement, 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, EEG Telemetry System, Typical EEG system artifacts, faults, troubleshooting, and maintenance	07
8.	**Electrical Safety and Standards :** Physiological effects of electricity, Important susceptibility parameters, distribution of electric power, Macro shock hazards, Electrical- Safety codes and standards, basic approaches to protection against shock, power distribution protection, equipment protection	05
	Total	**45**

List of References:

1. Joseph J. Carr and John M. Brown, *"Introduction to Biomedical Equipment Technology"*, Pearson Education.
2. John. G. Webster, *"Medical Instrumentation- Application and Design"*, John Wiley & Sons.
3. R.S. Khandpur,*"Handbook of Biomedical Instrumentation"*, Mc Graw Hill.
4. Leslie Cromwell, Fred J.Weibell, *"Biomedical Instrumentation and Measurements"*, PHI
5. Willis J. Tompkins,*"Biomedical Digital Signal Processing"*, Prentice-Hall of India.
6. Suresh R. Devashahayan,*"Signals and Systems in Biomedical Engineering"*, Kluwer academics/ Plenum publication.

Course Outcomes (COs):

At the end of this course, students will be able to:

1. Understand anatomy, physiology of important physiological system of human body and design of medical instruments (particularly electronics part) by evaluating medical parameter measurement constraint.
2. Analyze important vital sign parameters to evaluate certain disease conditions.
3. Understand of the electric safety of the medical instruments