SEMESTER S5
BIOMEDICAL INSTRUMENTATION

Course Code	PEICT522	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Gain fundamental knowledge of biopotential acquisition and analysis:
2. Develop an understanding of signal conditioning principles for biomedical applications
3. Become familiar with the measurement of various physiological parameters

KTU SPECIAL

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**BASIC ANATOMY AND PHYSIOLOGY**: Origin of bio potential and its propagation, Nervous system, Muscular system, Cardiovascular system, Respiratory System. **BIOPOTENTIAL ELECTRODES**: Electrode-electrolyte interface, electrode–skin interface, half-cell potential, Contact impedance, polarization effects of electrode – non polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - motion artifacts- Monopolar and bipolar electrode configurations	9
2	Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven ‘s triangle, standard 12 lead system, Principles of vector cardiography. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. **SIGNAL CONDITIONING CIRCUITS:** Need for bio-amplifier - differential bio-amplifier, Design of bio-amplifiers	9

	for the measurement of physiological variables. Power line interference, Band pass filtering. Working of isolation amplifiers, (transformer, capacitive and optical isolation), isolated DC amplifier and AC carrier amplifier. (Circuit diagram and working only)	
3	**MEASUREMENT OF NON-ELECTRICAL PARAMETERS:** Temperature and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers, Systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement. Pulmonary function measurements-Spirometer, Photo plethysmography, Body plethysmography.	**7**
4	**ELECTRICAL SAFETY IN MEDICAL ENVIRONMENT:** Types of Electrical hazards, Physiological effects of electric current – Threshold Values for Electrical Shock, shock hazards from electrical equipment – leakage current-Instruments for checking safety parameters of biomedical equipment, Methods of accident prevention, Electrical Safety Standards **ASSISTIVE AND THERAPEUTIC EQUIPMENTS:** Pacemakers, defibrillators, ventilators, diathermy, Heart-Lung machine and dialyzers. (Diagrams and Basic working only) **BIOMEDICAL IMAGING** X-ray, Computed Tomography, Ultrasound, Magnetic resonance Imaging. (Diagrams and Basic working only)	**11**

KTU SPECIAL

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

KTU SPECIAL

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the origin of bioelectric potentials, and working of human nervous system, muscular system, cardiovascular system and respiratory system, and describe the theory, construction and working of bio-electrodes	**K2**
CO2	Explain the measurement of biomedical signals such as ECG, EEG and EMG, and explain working of signal conditioning circuits and isolations amplifiers.	**K2**
CO3	Describe the measurement of non-electric parameters of heart and lungs	**K2**
CO4	Perceive the concepts of assistive & therapeutic equipment such as Pacemakers, defibrillators, ventilators, diathermy, Heart-Lung machine & dialyzers, electrical safety in medical environment and basing working of imaging modalities such as X-Ray, CT, US and MRI	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					2						3
CO2	3					2						3
CO3	3					2						3
CO4	3					2						3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Biomedical Instrumentation and Measurements	L. Cromwell, F. J. Weibell, and L. A. Pfeiffer	Pearson Education, Delhi	2nd, 2015
2	Medical Instrumentation Application and Design	John G Webster	Wiley India Private Limited	5th, 2021

KTU SPECIAL

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Biomedical Equipment Technology	J. J. Carr and J. M. Brown	Pearson Education, Delhi	4th,2002
2	Hand Book of Bio-Medical Instrumentation	R.S. Khandhpur	McGraw Hill Education (India) Private Limited	3rd, 2014
3	Principles of Applied Bio-Medical Instrumentation	L.A. Geddes and L.E.Baker	**Wiley India Pvt Ltd**	3rd, 2008
4	Principles of Medical Electronics and Bio-medical Instrumentation	C. Rajarao and S.K. Guha	Universities press (India) Ltd	2000

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://youtube.com/playlist?list=PLm_MSClsnwm-kjSqlfwaEhKwfnnfLUUBM&si=UkPImh4yMqtPBNVI
2	https://youtube.com/playlist?list=PLm_MSClsnwm-kjSqlfwaEhKwfnnfLUUBM&si=UkPImh4yMqtPBNVI
3	https://youtube.com/playlist?list=PLm_MSClsnwm-kjSqlfwaEhKwfnnfLUUBM&si=UkPImh4yMqtPBNVI
4	https://youtube.com/playlist?list=PLm_MSClsnwm-kjSqlfwaEhKwfnnfLUUBM&si=UkPImh4yMqtPBNVI

KTU SPECIAL