SEMESTER S4
BIOMEDICAL INSTRUMENTATION

Course Code	**PEMRT412**	**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 code)	**Course Type**	Theory

Course Objectives:

1. The course aims to give a brief introduction to human physiology.
2. The course presents various instrumentation systems used for measurement and analysis of physiological parameters.

SYLLABUS

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Module No.	Syllabus Description	Contact Hours
1	**Introduction to Biomedical Instrumentation** Overview of biomedical instrumentation – Basic principles and concepts –Source of bioelectric potentials - Resting and action potential – Propagation of action potentials - Bioelectric potentials example (ECG, EEG, EMG) - Electrode skin interface - Types of electrodes - Limb electrodes – Floating electrodes - Pre-gelled disposable electrodes - Micro, needle and surface electrodes.	9
2	**Physiological measurements** Heart and cardio vascular system - Electro conduction system of the heart-Electrocardiograph(ECG) – Electrodes and leads – Einthoven triangle - ECG read out devices - ECG machine – Block diagram - Measurement of blood flow and cardiac output - Measurement of heart sounds – Phonocardiography - Electroencephalogram (EEG) measurement - Electromyogram (EMG).	9
3	**Biomedical Imaging Techniques** X-rays - Principles of generation - Uses of X-rays - Diagnostic still picture – Fluoroscopy – Angiography – Endoscopy - Diathermy - Basic principle of computed tomography	

	(CT) - Magnetic resonance imaging (MRI) system and nuclear medicine imaging system (PET, SPECT) – Radiation therapy - Ultrasound imaging system - Introduction and basic principle	
4	**Electrical safety and Therapeutic Devices** Physiological effects of electric current – Shock hazards from electrical equipment, Leakage current - Electrical safety analyser – Testing of biomedical equipment – Method of accident prevention. Cardiac pacemakers – Internal and external pacemakers – Defibrillators –Artificial heart valves - Heart lung machine - Biotelemetry - Introduction to telemedicine - Cyber medicine.	**9**

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**

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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**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the fundamental principles and concepts of biomedical instrumentation, biopotential signals produced by the human body and electrodes used for biopotential signal acquisition.	**K2**
CO2	Understand the various physiological measurement techniques for cardiovascular, nervous and muscle systems.	**K2**
CO3	Acquire knowledge of the fundamental principles underlying medical imaging techniques	**K2**
CO4	Summarize the importance of electrical safety within medical environment	**K2**
CO5	Discuss the application of electronics in therapeutic applications and the field of biotelemetry	**K2**

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

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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	2									
CO2	3	2	2									
CO3	3	2	2									
CO4	3	2	2			2						
CO5	3	2	2			2						

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	Medical Instrumentation: Application and Design	John G. Webster	John Wiley and Sons	4th ed., 2010
2	Handbook of Biomedical Instrumentation	R. S. Khandpur	McGraw Hill Education (India) Private Limited	3rd ed., 2014

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Principles of Biomedical Instrumentation	Andrew G. Webb	Cambridge University Press	1st ed., 2018
2	Biomedical Instrumentation and Measurements	L. Cromwell, F. J. Weibell and E. A. Pfeiffer	Prentice Hall	2nd ed., 1980
3	Fundamentals of Biomedical Engineering	G.S. Sawhney	New Age International Publishers	1st ed., 2007
4	Medical Imaging Signals and Systems	J. L. Prince and J. M. Links	Pearson Prentice Hall,	1st ed., 2006

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Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.swayam2.ac.in/nou24_bt07/preview
2	https://onlinecourses.swayam2.ac.in/nou24_bt07/preview
3	https://archive.nptel.ac.in/courses/102/105/102105090/ https://onlinecourses.swayam2.ac.in/nou24_bt07/preview
4	https://onlinecourses.swayam2.ac.in/nou24_bt07/preview