SEMESTER S6

BIOMEDICAL ENGINEERING

Course Code	**OEAET612**	**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)	NIL	**Course Type**	Theory

Course Objectives:

1. To familiarize biomedical engineering and its applications.
2. To understand the physiology of major systems of the body for designing biomedical devices.
3. To impart knowledge about various biomedical devices.

SYLLABUS

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Module No.	Syllabus Description	Contact Hours
1	Introduction to biomedical instrumentation system, overview of physiological systems - heart, lungs and muscles. Sources of bioelectric potential - Resting and action potential, propagation of action potentials. Bioelectric potentials (introduction only) - ECG, EEG, EMG, ERG, EOG and EGG. Electrode theory - Nernst relation. Bio potential electrodes - microelectrodes, skin surface electrodes and needle electrodes.	9
2	Overview of electro conduction system of the heart. Electrocardiography - ECG lead configurations, ECG recording system, Einthoven triangle, analysis of ECG signals. Measurement of blood pressure - Direct, indirect and relative methods, auscullatory method, oscillometric and ultrasonic non-invasive pressure measurement. Measurement of blood flow - Electromagnetic and ultrasonic blood flow meters.	9

3	Overview of the human nervous system, action potential of brain, brain waves, types of electrodes, placement of electrodes, evoked potential, EEG recording and analysis of EEG. Electromyography - Nerve conduction velocity, instrumentation system for EMG measurement. Overview of the physiology of respiratory system, Respiratory parameters, spirometer, body plethysmographs, gas exchange and distribution.	**9**
4	Therapeutic Equipments (Principle, block schematic diagram, working and applications) - Pacemakers, cardiac defibrillators, heart–lung machine, dialyzers, surgical diathermy equipment and ventilators. Medical Imaging systems (Basic Principle only) - X-ray imaging, properties and production of X-rays, computed tomography, Magnetic resonance imaging system and nuclear medicine system. Ultrasonic imaging system - introduction and basic principle. Colour doppler systems.	**9**

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

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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**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the need and applications of biomedical instrumentation	**K2**
CO2	Understand the physiology of major systems of the body for designing biomedical devices.	**K3**
CO3	Illustrate the principle of patient monitoring and therapeutic systems	**K2**
CO4	Explain the principle of medical imaging techniques	**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		3	2	3	3		3				3
CO2	3		3	2		3		3				3
CO3	3		3	2	3	3		3				3
CO4	3		3	2	3	3		3				3

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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	Handbook of Biomedical Instrumentation	Khandpur R.S	McGraw-Hill	3rd Edition, 2014
2	Medical Instrumentation: Application and Design	John G. Webster, Amit J. Nimunkar	WILEY	5th Edition, 2020
3	Biomedical Instrumentation And Measurements	Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer	Pearson Education India	2nd Edition, 2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Biomedical Instrumentation: The technology of the patient care	Barbara L. Christe	Cambridge University Press	2nd Edition, 2017
2	Introduction to Biomedical equipment Technology	Joseph J.carr and John M. Brown	Wiley and Sons	4th Edition, 2000
3	Principle of Biomedical Instrumentation and Measurement	Richard Aston	Merrill Education/Prentice Hall.	1st Edition, 1990

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/108/105/108105101/
2	https://archive.nptel.ac.in/courses/108/105/108105101/ https://archive.nptel.ac.in/courses/102/105/102105090/
3	https://archive.nptel.ac.in/courses/108/105/108105101/ https://archive.nptel.ac.in/courses/102/105/102105090/
4	https://archive.nptel.ac.in/courses/102/105/102105090/

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