

SEMESTER-IV
DEPARTMENT OF INSTRUMENTATION
Category I

(B.Sc. Honours in Instrumentation)

DISCIPLINE SPECIFIC CORE COURSE – 10: Biomedical Instrumentation (INDSC4A)

CREDIT DISTRIBUTION, ELIGIBILITY, AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Biomedical Instrumentation (INDSC4A)	04	03	-	01	Class XII passed with Physics + Mathematics/Applied Mathematics + Chemistry/Computer Science/Informatics Practices	Sensors and Transducers

Learning Objectives

The Learning Objectives of this course are as follows:

- To identify and describe various biomedical signals.
- To describe the origin of biopotentials and explain the role of biopotential electrodes.
- To understand the synchronization between the physiological systems of the body.
- To understand the basic measurement principles behind biomedical instrumentation.
- To realize the working principle of numerous biomedical imaging techniques.
- To analyze the applications of biosensing in different domains of healthcare.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Analyze the origin of various bioelectric signals (ECG, EEG) and the method of recording using different types of electrodes.
- Develop basic knowledge about the Cardiovascular, respiratory and nervous systems.

- Develop an understanding of the measurement principles of medical instrumentation including measurement of respiratory function, cardiac variables, blood pressure as well as medical devices.
- Design various biomedical instruments with the help of respective transducers.

SYLLABUS OF DSC-10

Unit-1

(10 Hours)

Biopotentials, Bio amplifiers, and Bioelectrodes: Introduction to bio-electric potential, bio- amplifier, components of man Instrument system, types of biomedical systems, design factors and limitations of biomedical instruments, terms, and transducers to measure various physiological events, types of bio-potential electrodes (Body surface electrodes, Internal electrodes, Microelectrodes), electrolyte interface, electrode circuit model, impedance and polarization, Properties of electrodes

Unit-2

(13 Hours)

Cardiac vascular system & measurements: ECG: origin, Instrumentation, the bipolar system lead system I, II, III, Einthoven's triangle, Augmented lead system, unipolar chest lead system, types of display. Blood pressure measurements: direct, indirect. Pacemakers- Internal, External

Unit-3

(11 Hours)

Respiratory Measurement Systems: Types of volume, types of measurements, Instrumentation of respiratory system, principle & types of pneumograph, Spirometer, pneumotachometers, nitrogen washout technique

Unit-4

(11 Hours)

Nervous system: Action potential of the brain, brain wave, Instrumentation of Electroencephalography (EEG), electrodes used for recording EEG analysis. Conventional X-ray, properties, generation of X-ray, Thermal imaging system, working, IR detectors, applications.

Practical component:

(30 hours)

1. Characterization of biopotential amplifier for ECG signals.
2. Study on ECG simulator.
3. Recording of EEG.
4. Measurement of blood pressure and measurement of heart sound using a stethoscope.
5. Study of pulse rate monitor with alarm system.
6. Determination of pulmonary function using a spirometer.
7. Measurement of respiration rate using thermistor /other electrodes.
8. Study of Respiration Rate monitor/ apnea monitor.

Essential/recommended readings

1. Cromwell L., Wiebell F. J., Pfeiffer EA, Biomedical Instrumentation and Measurements, 2nd Edition, Prentice Hall (2010).
2. Carr J. J, Brown J. M. Introduction to Biomedical Equipment Technology, 4th Edition, Pearson Education Inc (2010).
3. Khandpur R.S., Handbook of Biomedical Instrumentation, 2nd Edition, Tata McGraw-Hill Publishing (2009).
4. Joseph D. Bronzino, The Biomedical Engineering Handbook, IEEE Press (2015), 4th edition, Volume 1.

Suggestive readings

1. Richard Aston, Principles of Biomedical Instrumentation & Measurement, 1st edition, Merrill Publishing Company (1990).
2. Mandeep Singh, Introduction to Biomedical Instrumentation, 2nd Edition, PHI learning private limited (2014).

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.