

Biomedical Instrumentation (404204)

Teaching Scheme:

Lectures: 3 Hrs/ Week

Examination Scheme:

In semester Assessment:

Phase I : 30 Marks

End semester Examination:

Phase II: 70 Marks

Course Objectives:

- To familiarize students with various medical equipments and their technical aspects and learn to design, build, and test biomedical instrumentation equipment.
- Analyze how noise from the environment, instruments and other physiologic systems can create artifacts in instrumentation.
- Learn operation of ECG, EEG, EMG and EOG measurement techniques and their applications in biomedical signal processing.
- To learn and understand principle of different clinical lab instrumentation and Radiology Instrumentation.

Course Outcomes:

Upon successful completion of this course, students will be able to:

- Have a clear knowledge about human physiology system.
- Have knowledge of the principle operation and design and the background knowledge of biomedical instruments and specific applications of biomedical engineering.
- Understand operation of the cardiac, respiratory and neural physiological systems. Study the designs of several instruments used to acquire signals from living systems. Examples of instruments studied include ECG, blood pressure monitors, EEG, MRI, and ultrasound.
- Understand working principle of Blood Pressure Measurement (Direct and Indirect Methods). Blood Flow Measurement, Finger Plethysmography, Echocardiography, Stress Testing System, Beside Monitors, Central Monitoring System, Life Saving Devices: Pacemakers, Defibrillators.
- Understand working principle of Clinical Lab Instruments
- Understand working principle and applications of Radiology Instrumentation.

Unit I: Introduction:

6L

Introduction to Biomedical Instrumentation System: Overview of Bio Instrumentation, Sources of bioelectric potential, Types Bio- Signals, Biomedical Instrumentation System and its components.

Transducers and Sensors for Bio Signal Measurements: Sensors and Transducers, Biomedical Electrodes, Model of biomedical electrode, Silver-Silver chloride reference electrode, Types of electrodes for measurement of EEG, ECG, EMG, PCG, Respiration, Temperature. Chemical Sensors to measure PH, PO₂, Glucose, O₂, Skin contact impedance, Artifacts and noise in medical instrumentation.

Unit II: Cardiovascular System

6L

Introduction to Heart System, Heart Structure, Functioning of Heart System, Cardiac cycle, ECG Electrodes, Electrocardiograph, Lead Configurations to measure ECG, Einthoven Triangle, Vectocardiography, Normal and abnormal ECG, ECG Signal Processing, ECG Amplifiers and Filters , ECG Machine, Heart sounds.

Unit III: Nervous System and Electromyography

6L

Introduction to Nervous System-Anatomy: The anatomy of the nervous system, The Autonomic nervous System, 10-20 electrode placement system for EEG measurement, Evoked-Potentials, Types and significance of EEG Signal, EEG machine, EEG amplifiers and filters, Analysis of Diseases using EEG.

Electromyography (EMG)

Muscle contraction mechanism, Myoelectric voltages, Electromyography (EMG), EMG Machine.

Unit IV: Medical Instruments and Measurements

6L

Life Saving Devices: Pacemakers, Defibrillators, Ventilators, Introduction to Blood Pressure Measurement (Direct and Indirect Methods). Blood Flow Measurement, Finger Plethysmography, Echocardiography, Stress Testing System, Beside Monitors, Central Monitoring System

Unit V: Clinical Lab Instruments

6L

Blood Cell Counter, Electron Microscope, Colorimeter, Autoanalyser, Flame photometer, PH measurement/Blood Gas Analyzer for measurement of PH, PO₂ & PCO₂, Pulse Oximeter, Introduction to Dialysis System. Electrical Safety of Instruments: Grounding and Shielding, Issues of Noise Pollution around Hospitals.

Unit VI: Radiology Instrumentation & Biotelemetry

6L

Introduction to Radiology Instrumentation such as X-Ray Machine, Computer Tomography (CT Scan), MRI Machine, Introduction to Ultrasonic Doppler Machine, Laser applications in Biomedical.

Biotelemetry: Introduction to Biotelemetry, Physiological Parameters adaptable to biotelemetry, components of Biotelemetry system, Implantable Units, Application of Telemetry in Patient Care.

Text Books

1. Carr and Brown, Biomedical Instrumentation.
2. Cromwell, Biomedical Instrumentation and Measurement, PHI.

Reference Books

1. Webster, Application and Design of Medical Instruments.
2. R. S. Khandpur, Biomedical Instrumentation.

List of Experiments:

Students are expected to perform Minimum 8 experiments from the list mentioned below.

1. To study ECG Machine (Single channel or Multichannel).
2. Interface of PC simulated waveform with ECG machine.
3. ECG \ QRS Detector + Counter to display heart rate
4. To study and measure pulse rate using finger plethysmography.
5. To study Defibrillator/pacemaker
6. To study and measure Blood Pressure using sphygmomanometer/ Digital BP Instrument
7. To study EEG/EMG Machine.
8. Measure body temperature using Digital Clinical Thermometer
9. Measurement of concentration using spectrophotometer
10. To study Blood cell counter.
11. Study of Bedside Monitor, Drip Rate Monitor (ICU Monitor)
12. Study of PH measurement System.
13. Study of Dialysis System
14. Study of Clinical Lab Instrumentation.
15. Study of Laser Treatments in Medicines.