APPE3007 BIO-MEDICAL INSTRUMENTATION (3-0-0)

Course Objectives

1. Introduce the fundamentals of biomedical engineering and the need for medical instrumentation systems.
2. Explain the origin and characteristics of bioelectrical signals and electrode–tissue interface phenomena.
3. Develop understanding of physiological transducers and their performance characteristics.
4. Familiarize students with biomedical signal recording systems and signal conditioning techniques.
5. Provide knowledge of design constraints, grounding techniques, safety considerations, and regulatory requirements of medical devices.

Module-I: (7 Hours)

Introduction to Bioengineering, Biochemical Engineering, Biomedical Engineering, Sources of Biomedical Signals, Basic medical Instrumentation systems and their need, use of microprocessors in medical instruments, PC based medical Instruments, general constraints in design of medical Instrumentation system & Regulation of Medical devices.

Module-II: (5 Hours)

Bioelectrical Signals & Electrodes: Origin of Bioelectric Signals, Electrocardiogram, Electroencephalogram, Electromyogram, Electrode-Tissue Interface, Polarization, Skin Contact Impedance, Motion Artifacts.

Module-III: (7 Hours)

Electrodes for ECG: Limb Electrode, Floating Electrodes, Pre-gelled disposable Electrodes, Electrodes for EEG, Electrodes for EMG. Physiological Transducers: Introduction to Transducers, Classification of Transducers, Performance characteristics of Transducers, Displacement, Position and flow and pressure Transducers.

Module-IV: (5 Hours)

Strain gauge pressure transducers, Thermocouples, Electrical Resistance Thermometer, The mister, Photovoltaic transducers, Photo emissive Cells & Biosensors (Biochemical sensors).

Module-V: (6 Hours)

Recording Systems: Basic Recording systems, General considerations for Signal conditioners, Preamplifiers, Differential Amplifier, Isolation Amplifier, Electrostatic and Electromagnetic Coupling to AC Signals, Proper Grounding (Common Impedance Coupling).

Course Outcomes

CO1 : Explain the principles of biomedical engineering, sources of biomedical signals, and the need for medical instrumentation systems.

CO2 : Describe the origin, characteristics, and measurement techniques of bioelectrical signals such as ECG, EEG, and EMG, including electrode–tissue interface effects.

CO3 : Classify and select appropriate physiological transducers (pressure, temperature, displacement, flow, and biosensors) for specific biomedical applications based on performance characteristics.

CO4 : Analyze the working principles and applications of various transducers such as pressure, temperature, and optical sensors, including biosensors used in biomedical systems.

CO5 : Analyze biomedical recording systems including preamplifiers, differential and isolation amplifiers, and evaluate the effects of noise, grounding, and signal coupling.

Text Books:

[1] Hand Book of Biomedical Instrumentation by R.S. Khandpur-2nd Edition, Tata McGrawHill, 2003.
[2] Introduction to Biomedical Engineering by Michael M.Domach, Pearson Education Inc,-2004.
[3] Biomedical Instrumentation and Measurements- by Leslie Cromwell, Fred J.Weibell, Erich A. Pfeiffer, 2ndEdition, PHI learning Pvt. Ltd

Reference Books:

[1] Introduction to Biomedical Equipment Technology, 4e. ByJOSEPH.J.CAAR &JOHN M.BROWN (Pearson education publication).
[2] Medical Instrumentation-application & design. 3e – By JOHN.G. WEBSTER John Wiley & Sons publications.