

BMPC3003 BIOMEDICAL INSTRUMENTATION (3-0-0)

Course Objective:

This course provides comprehensive knowledge of biomedical instrumentation used for physiological monitoring and diagnosis. It covers the principles and applications of sensors, electrodes, amplifiers, patient monitoring systems, imaging technologies, and therapeutic devices, enabling students to understand, analyze, and apply instrumentation techniques in modern healthcare and clinical environments.

Module-I: (10 Hrs)

Physiology and transducers

Cell and its structure, Resting and Action Potential, Nervous system: Functional organization of the nervous system, Structure of nervous system, neurons, synapse, transmitters and neural communication, Cardiovascular system, respiratory system, Basic components of a biomedical system, Transducers, selection criteria, Piezo-electric, ultrasonic transducers, Temperature, measurements-Fiber optic temperature sensors.

Module-II: (12 Hrs)

Electro-Physiological measurements Electrodes:

Limb electrodes, floating electrodes, pre-gelled disposable electrodes, Micro, needle and surface electrodes, Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers, Isolation amplifier. ECG, EEG, EMG, ERG, Lead systems and recording methods, Typical waveforms. Electrical safety in medical environment: shockhazards, leakage current-Instruments for checking safety parameters of biomedical equipment

Module-III: (10 Hrs)

Non-electrical parameter measurements

Measurement of blood pressure, Cardiac output, Heart rate, Heart sound Pulmonary function measurements, spirometer, Photo Plethysmography, Body Plethysmography, Blood Gas analyzers : pH of blood, measurement of blood pCO₂, pO₂, finger-tip oximeter, ESR, GSR, measurements, Standard HL7

Module-IV: (08 Hrs)

Medical Imaging

Radiographic and fluoroscopic techniques, X rays, Computer tomography, Mammography, MRI, fMRI, Ultrasonography, Endoscopy, Thermography, Different types of bio telemetry systems and patient monitoring.

Module-V: (08 Hrs)

Assisting and therapeutic equipments

Pacemakers, Defibrillators, Ventilators, Nerve and muscle stimulators, Diathermy, Heart Lung machine, Audiometers, Dialyzers, Lithotripsy.

Course Outcomes (COs)

- CO1: Identify and describe the structure and function of physiological systems and biomedical transducers used for clinical measurement.
- CO2: Explain the working principles of electrodes, amplifiers, and common bio-signal acquisition systems such as ECG, EEG, and EMG.
- CO3: Apply knowledge to measure and interpret non-electrical physiological parameters like blood pressure, cardiac output, and oxygen saturation.
- CO4: Analyze different medical imaging modalities such as X-ray, CT, MRI, and ultrasonography with respect to their biomedical applications.
- CO5: Evaluate the functionality and safety considerations of therapeutic and supporting devices like pacemakers, defibrillators, ventilators, and dialyzers.

Reference Books:

1. R.S.Khandpur, 'Hand Book of Bio-Medical instrumentation', Tata McGraw Hill Publishing Co Ltd.,2003.
2. Leslie Cromwell, Fred J.Weibell, Erich A. Pfeiffer, 'Bio-Medical Instrumentation and Measurements', 11th edition, Pearson Education, 2002/PHI.
3. J.Webster, 'Medical Instrumentation', John Wiley & Sons, 1995.
4. L.A.Geddes and L.E.Baker, 'Principles of Applied Bio-Medical Instrumentation', John Wiley & Sons, 1975