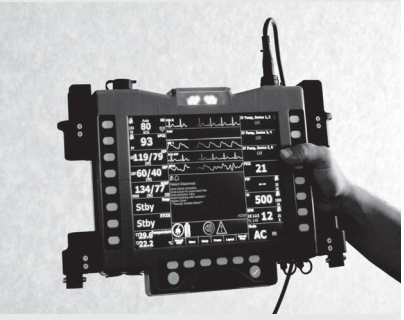

16BM303 BIOMEDICAL INSTRUMENTATION

Hours Per Week :

L	T	P	C
3	1	2	5

Total Hours :

L	T	P
45	15	30

WA/RA	SSH/HSH	CS	SA	S	BS
20	46	6	12	3	2

Course Description and Objectives:

This course aims at basic and advanced working principles, medical sensors and devices and their applications. The objective of the course is to design and experiment with amplifiers for bio potential measurements and therapeutic instrumentation such as pacemakers, defibrillators and prosthetic devices.

Course Outcomes:

The student will be able to:

- construct instrumentation systems for various applications.
- acquire and process different physiological signals.
- handle display devices and recorders are also considered.
- display or record acquired signals.

SKILLS:

- ✓ *Understand biomedical instrumentation and their parameters.*
- ✓ *Analyze different display devices.*
- ✓ *Determine and analyze the bio potentials and how they are interpreted.*
- ✓ *Acquisition of biological signals and feeding them to instruments to make meaning out of it.*
- ✓ *Design and construct the circuits for amplification of biomedical signals.*

UNIT - 1 **L-9, T-3**

INTRODUCTION TO MEDICAL INSTRUMENTATION: Block diagram of a medical instrumentation system; Bio-signals: Origin and characteristics of Bio potentials-ECG, EEG, EGG, EMG, ENG, EOG, and ERG; Problems encountered with measurements from human beings; Generalized medical instrument specifications, Electrode-Electrolyte Interface, Half-cell potential, Offset Voltage; Types of Electrodes- External, Internal and Microelectrodes; Mathematical Treatment of Electrodes- Equivalent circuits and Applications.

UNIT - 2 **L-9, T-3**

MEDICAL DISPLAY DEVICES AND RECORDERS: Display Devices- Basic requirements for the display and recording of Bio-signals, Types of medical display devices; Medical recorders: Classification of recorders, PMMC writing systems; General features of ink-jet, Thermo-sensitive and optical recorders; Oscilloscopes: Basic description, Cathode Ray Oscilloscope (CRO), Dual beam oscilloscope, Analog storage oscilloscope, Digital storage oscilloscope, Medical, Multibeam and Non-fade display systems; Liquid crystal displays- Introduction, Passive-matrix and active, matrix addressed LCDs.

UNIT - 3 **L-9, T-3**

Cardiac Instrumentation: Electrocardiography, Block diagram, Circuits, electrodes and their placement; Lead configuration and general ECG waveforms; ECG monitors: Single channel and multi-channel ECG systems, Holter monitors, Stress test systems; Blood Pressure measurement- Introduction to blood pressure, Direct and indirect methods of Blood Pressure measurements; Blood Flow measurement: Introduction to hemodynamics, Electromagnetic and Ultrasonic techniques of Blood flow measurement; Heart sounds- Origin of Heart Sounds, Types of microphones for heart sound measurement, Contact and non-contact type of measurement, Phonocardiography.

UNIT - 4 **L-9, T-3**

NEURO-MUSCULAR INSTRUMENTATION: Electroencephalography- EEG-Block diagram and circuits, Electrodes and their placement, Lead configuration and general EEG graphs; Evoked potentials and their measurement, Filters for EEG rhythm analysis, Electromyography: Introduction to EMG signals, EMG-Block diagram and Circuits-Electrodes and their placement; Nerve conduction velocity determination using EMG, Stimulators for EMG recording.

UNIT - 5 **L-9, T-3**

Medical Analytical Instrumentation: Methods of chemical analysis, Absorption Photometry, emission photometry, Flurometry, Colorimeter, Spectrophotometer, Flame photometer, Mass spectrophotometer, Electrophoresis, chromatography, Blood gas analyzer, Semi and fully automated analyzers.

LABORATORY EXPERIMENTS

Course Outcomes:

Students will be able to :

- observe biological signals from the simulators.
- tap bio bio potentials form the systems and observe the differences.
- design a biopotential amplifier using basic components.

LIST OF EXPERIMENTS: Total hours-30

I. Design systems

1. Experiment on Electrodes- ECG, EEG, EMG

ACTIVITIES:

- *Analyze ECG signals via simulators.*
- *Differentiate abnormalities using bio amplifiers,*
- *Build and test circuits.*
- *Analyze Medical chemicals using spectrophotometers, flame photometers.*

2. Design/Fabrication and test:

   (i) ECG system

   (ii) EEG system

   (iii) EMG system

   (iv) GSR system

II. Clinical Experiments:

1. Colorimeter
2. Spectrophotometer
3. Electrophoresis Apparatus (Paper and Gel)
4. Body mass index experiment
5. Tuning fork experiment to test the hearing ability of the subject
6. Blood Pressure measurement by using Sphygmomanometer

III. Design Experiments

1. Design of Instrumentation amplifiers for ECG, EEG, and EMG.
2. Design of filters for ECG, EMG, and EEG.
3. Common Mode Rejection Ratio (CMRR) of Medical instrumentation amplifier
4. Design of RC phase shift oscillator for LVDT.

TEXT BOOKS:

1. Webster J.G., "Medical Instrumentation Application and Design", 4th edition, Houghton Mifflin, 2009.
2. Khandpur R.S. "Hand Book of Biomedical Instrumentation", 3rd edition, Tata McGrawHill, 2003.

REFERENCE BOOKS:

1. Carr and Brown, "Introduction to Bio medical equipment technology", 4th edition, Pearson, 2000.
2. Khandpur R.S.,"Hand Book of Analytical Instrumentation", 2nd edition, Tata McGrawHill,2010.
3. John Enderle, Susan M. Blanchard, and Joseph Bronzino, "Introduction to Biomedical Engineering", 2nd edition,2005.