## 4EC42: BIOMEDICAL INSTRUMENTATION
## Credits - 4 (LTP: 3,0,1)

**Course Objective:**

To understand the concepts of various anatomy of the human body and related to that, the designing of fundamental instrumentation circuits using appropriate sensors. This subject will help to learn the concepts of the various bio-potentials related to the human body which can help them to make real-time healthcare applications.

**Teaching and Assessment Scheme:**

| Teaching Scheme (Hours per week) | | | Credits | Assessment Scheme | | | | |
|---|---|---|---|---|---|---|---|---|
| L | T | P | C | Theory Marks | | Practical Marks | | Total Marks |
| | | | | ESE | CE | ESE | CE | |
| 3 | 0 | 2 | 4 | 60 | 40 | 20 | 30 | 150 |

**Course Contents:**

| Unit No. | Topics | Teaching Hours |
|---|---|---|
| 1 | **Introduction of Biomedical Instrumentation:** Medicine and Medical Devices a review, Generalized block diagram of the medical instrumentation system, Classification of Biomedical Instruments. Interference in the measurements and modifying inputs, Compensation techniques. | 04 |
| 2 | **Bio-Potentials:** Human body and Cell structure, Electrical Activity of Excitable Cells, The action and Resting potentials. Introduction of Bio-potentials related to the human body. ECG, EMG, EEG, ERG etc. | 06 |
| 3 | **Bioelectrodes-Sensors-Transducers:** Introduction of resistive, capacitive and inductive sensors, Piezoelectric sensor, displacement and temperature measurement, optical and radiation sensors-transducers, Introduction and Classifications of the Bio-electrodes. | 08 |
| 4 | **Cardiovascular system and measurements :** The anatomy of human heart. Electrocardiogram generation and measurements, The ECG Instrumentation lead techniques and signal conditioning, Measurement of Blood pressure, blood flow, blood volume and heart sound, Special techniques of ECG measurement. Introduction of ECG Bio-signal Processing and Signal Conditioning. | 08 |
| 5 | **Biomedical measurements and Equipments:** Digital revolution in the biomedical equipment's, EEG and its measurements. 10-20 measurements. Heart Rate and Pace-Makers, Defibrillators, Imaging techniques and its fundamentals, X-Ray, MRI, CT-Scan, Radiography, PET Scan, Ultrasonography, laser and robotics surgery equipments, Equipments in ICU and Patient monitoring systems. | 08 |

| Unit No. | Topics | Teaching Hours |
|---|---|---|
| 6 | **Electrical Hazards and Patient safety :**<br>Physiological effect of the electrical current on human, Significance of electrical danger, Micro and Macro shocks, Ground shocks, Hazards and methods of Accident prevention. | 06 |
| | **Total** | **40** |

**List of References:**


1. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, *"Biomedical Instrumentation and Measurements",*PHI Private Limited,2nd Edition, 2012.
2. John G. Webster, *"Medical Instrumentation Application and Design"*, WSE Wiley India Private Limited, 3rd Edition, 2012.
3. Joseph J. Carr, John M. Brown, *"Introduction to Biomedical Equipment Technology",* Pearson Education, 4th Edition, 2012.
4. R S. Khandpur, *"Handbook of Biomedical Instrumentation",* Tata McGraw Hill, 2nd Edition, 2002.
5. Rangaraj M Rangayyan, "Biomeidcal Signal Analysis: A Case-Study Approach",Wiley India, 2011.


**Course Outcomes (COs):**

By learning this course students will be able to

1. Recollect the basic knowledge of anatomy and physiology of human body.
2. Understand & Analyze important vital sign parameters to evaluate certain disease.
3. Categorize the differences of bio-potentials and its characteristics
4. Design bio-potential fundamental circuits and implement it for demonstration.
5. Study and measure various medical bio potentials.
6. Test safety related to electrical hazards and troubleshooting of biomedical instruments.