

Learning Outcomes:

The educational objectives of the course are to educate students to attain the following:

- Develop the understanding of the various Transducers and Biomedical sensors.
- Students will understand basic principle of Transducers and various Biomedical sensors.
- The course contents will enable the students to understand and design biomedical instrumentation systems.
- The contents will allow the students to understand the importance of the sensors and transducers for medical applications.

SYLLABUS

Unit No.	Topics	Lectures (Hours)
	Introduction to the overview and importance of the course. Commonly occurred problems in practice while using transducers & biosensors should be discussed separately in each unit.	
1	INTRODUCTION: Basic measurement system, Measurement, Measurand, Accuracy, Precision, Errors in Measurements, Signal and Noise, Calibration, Transduction principles, Classification and Characteristics of Transducers, Transducer parts and electrical design characteristics.	4
2	RESISTIVE TRANSDUCERS: Principle of resistive Strain Gauge, Type and construction of metal wire and Metal foil strain gauges, Strain gauge materials, Gauge factor, Semiconductor strain gauge, Signal Conditioning circuit, Temperature compensation, Bridge balance circuit, Strain Gauge type Blood pressure transducers.	5
3	DISPLACEMENT TRANSDUCERS: Potentiometric Transducers: Resistive, Resistive strain gauges. L.V.D.T, Inductive displacement transducer, Capacitive displacement transducers, Ultrasonic methods, Diaphragm displacement transducer, Applications.	4
4	TEMPERATURE TRANSDUCERS: Measurement Principle, characteristics, Design and Applications: Thermo resistive- Resistance Temperature Detectors (RTDs), Thermistor. Thermo electric - Thermocouple, PN junction diode. Non-contact type temperature measurements techniques: Radiation thermography, Infrared radiation, pyrometer, Infrared temperature probe, Optical Pyrometer.	5
5	PIEZOELECTRIC TRANSDUCERS: Piezoelectric phenomena and materials, Output voltage expression of Piezo crystal, Piezoelectric Force transducer, Piezoelectric acceleration transducer, Equivalent circuit of Piezoelectric transducers and Dynamic characteristics. Merits and demerits of Piezoelectric Transducers. Piezoelectric Ultrasonic Transducer: Construction and design, Electrical excitation, piezoelectric semiconductor and Applications.	4
6	PRESSURE TRANSDUCERS: Occlusive cuff methods. Force balance methods. Direct hydraulically coupled Catheter transducer system, Diaphragm pressure transducers. Piezoelectric Pressure transducer, Electrical transduction methods for Catheter tip transducer. Optical transducers. Implantable pressure transducer, Micro pressure transducer.	4

- 7 BIOPOTENTIAL ELECTRODES:** **7**
Electrode theory: the electrode / Electrolyte interface, Polarizable and non-polarizable electrodes, Liquid junction potential, Electrode potential, Application of Biopotential electrodes.
ECG electrodes: Surface electrodes, Silver- silver chloride electrodes, stainless steel electrodes, Electrode impedance and Electrode equivalent circuit.
EMG electrodes: Surface electrodes, Needle and Wire electrodes.
EEGelectrodes: Micro and suction electrodes- Glass microelectrodes, Metal microelectrodes, Suction electrodes, Microelectrode equivalent circuit.
- 8 BIOSENSORS:** **7**
 Definition of biosensor, Application and origin of biosensor, Transduction mechanism of biosensor, Blood gas and pH sensors, Bio-Analytical Sensor, Enzymatic biosensors, Optical Biosensors, PO₂ and PCO₂ sensor, Manufacturing techniques of Biosensors.

Term Work and Practical shall be based on the above syllabus.

Text Books:

1. Medical Instrumentation- Application and Design By John Wiley and Sons. John Webster. Inc., New York.
2. Industrial Instrumentation & Control, 2e By S.K.Singh

Reference Books:

1. Biomedical Transducers By: Prof. H. T. Kashipara.
2. Principles of Applied Biomedical Instrumentation By: L.A Geddas and L.E.Baker
3. Transducers for Biomedical measurements By: Richard S.C. Cobbold,
4. Biosensors By: E.A.H.Hall
5. Biomedical Sensors- Fundamentals and applications By: Harry.N. Norton
6. Biomedical Transducers and Instruments By: Tatsuo Togawa, Toshiya Tamora, and P. Ake Oberg