

| Course Code | Course Title | L | T | P | C |
|-------------|-----------------------------|---|---|---|---|
| 1151BM107 | BIO SENSORS AND TRANSDUCERS | 3 | 0 | 0 | 3 |

a) Course Category

Program core

b) Preamble

The student should be able to explain how physiological parameters are being measured.

c) Prerequisite

Basic Electrical Engineering, Basic Electronics Engineering

d) Related Courses

Bio Medical Instrumentation

e) Course Outcomes

Upon the successful completion of the course, students will be able to:

| CO Nos. | Course Outcomes | Knowledge Level (Based on Revised Bloom's Taxonomy) |
|---------|--|---|
| CO1 | Explain the principles of electrodes | K2 |
| CO2 | Explain the methods of pressure measurements | K2 |
| CO3 | Explain the methods of flow measurements | K2 |
| CO4 | Explain the methods of motion and force measurements | K2 |
| CO5 | Explain the methods of temperature measurements | K2 |

f) Course content

UNIT I INTRODUCTION TO SENSORS AND TRANSDUCER 9

Transducer and Measurement system - Static Characteristics – Dynamic Characteristics – Standards and Calibration – Types of Error. Bioelectric and Biomagnetic Measurement: Bioelectric events, Biomagnetic events. Electrode theory – Electrode-Electrolyte interface – Liquid junction potentials – Double layer – Electrode potentials. Surface Potential Electrodes: ECG electrodes – EMG electrodes – ECG electrodes. Glass electrodes – Metal Electrodes – Suction electrodes. Bio Magnetism: Biomagnetic fields – Magnetopneumography.

UNIT II PRESSURE MEASUREMENTS 9

Requirements of pressure measurements, Direct pressure measurement: Catheters and diaphragm type pressure measurement – Catheter tip pressure transducer, Pressure measurement in small vessels - Servo controlled, Pressure measurement in collapsible vessels – Interstitial pressure measurement – Differential pressure measurement. Indirect pressure measurement – Systolic, Diastolic and Mean blood pressure – Auscultatory and Oscillometric method.

UNIT III FLOW MEASUREMENT 9

Requirements of flow measurement, Blood flow meters in single vessel – Electromagnetic flow meter – Ultrasound flow meter – Indicator dilution method. Tissue blood flow meter – Venous Occlusion plethysmography. Respiratory Gas flow measurements – Gas flow sensors - Lung plethysmography.

UNIT IV MOTION AND FORCE MEASUREMENTS 9

Objects of Measurements, Motion Measurements: Displacement and rotation measurements by contact transducers - Displacement and rotation measurements of body in extracted tissue – Displacement measurement in vivo, Non contact measurement of displacement and rotation. Force measurements: Muscle contraction measurement – Force measurements in isolated muscles – In vivo measurement of muscle contraction.

UNIT V TEMPERATURE MEASUREMENT 9

Requirements of temperature measurement, Temperature transducers – Thermistor - Thermocouple– Thin film thermo resistive element – p-n junction diodes and transistors. Clinical thermometers: Indwelling thermometer probes – Rectal, Esophageal and Bladder temperature measurement, Tympanic thermometer, Zero heat flow thermometer.

Total 45 Hrs

g) Learning Resources

- 1) Tatsuo Togawa, Toshiyo Tamura, P. Ake Oberg, “Biomedical Transducers and Instruments”, CRC Press.

Reference Books

- 1) Ernest O Doebelin and Dhanesh N Manik, Measurement systems, Application and design, 5th edition, Mc Graw-Hill, 2007. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 2003.
- 2) Leslie Cromwell, “Biomedical Instrumentation and measurement”, Prentice hall of India, New Delhi, 2007.
- 3) John G. Webster, “Medical Instrumentation Application and Design”, John Wiley and sons, New York, 2004.
- 4) L.A Geddas and L.E.Baker, “Principles of Applied Biomedical Instrumentation”, John Wiley and Sons, Third Edition, Reprint 2008.
- 5) Albert D.Helfrick and William D. Cooper. Modern Electronic Instrumentation and Measurement Techniques”, Prentice Hall of India, 2007