

<b>Devi Ahilya Vishwavidhyalaya, Indore, India Institute of Engineering &amp; Technology</b>				<b>II Year B.Tech. (Electronics and Instrumentation Engineering)</b>	
<b>Course Code &amp; Name</b>	<b>Instructions Hours per Semester and Credits</b>				
<b>4REPC2  SENSORS AND TRANSDUCERS</b>	<b>Classroom Instruction (CI)</b>	<b>Lab Instruction (LI)</b>	<b>Term Work (TW) and Self Learning (SL)</b>	<b>Total no. of Hours Per semester</b>	<b>Total Credits (Total Hours/30)</b>
	<b>L</b>	<b>T</b>	<b>P</b>	<b>TW+SL</b>	<b>120</b>
	<b>20</b>	<b>10</b>	<b>20</b>	<b>70</b>	

### Course Learning Objectives:

1. To develop understanding about generalized measurement system and its characteristic features
2. To understand basic principles for the conversion of physical parameters into an electrical quantity
3. To gain knowledge about measurement of physical parameters like pressure, flow, temperature, strain, motion, position, acceleration and light etc
4. To be able to predict correctly the performance characteristics of various sensors
5. To set strategies for the selection and installation of suitable sensing elements

### Prerequisites:

Basic electrical and electronics engineering

## COURSE CONTENTS

### UNIT I : BASIC CONCEPT OF MEASUREMENTS AND INSTRUMENTS

Measurement Methods, Generalized measurement System, Classification of Instruments, Static & Dynamic Characteristics, Errors & Uncertainty measurement of system, Accuracy, Precision, Fidelity, speed of response, Linearization of techniques. Errors in measurement: Classifications of errors, Statistical Analysis, Linear & Non-linear Systems.

### UNIT II: TRANSDUCER FUNDAMENTALS AND DISPLACEMENT MEASUREMENT

Basic concept of Sensors and transducer, their comparisons, Classification of Transducer, working of transducers used for measurement of Displacement- resistive, inductive, and capacitive method, Linear and Angular Velocity moving coil and moving magnet method, various tachometers and stroboscope, Acceleration- seismic and piezo electric accelerometer, Working principle of Capacitive Transducer, Piezo-Electric Transducer, and LVDT.

### UNIT III: TEMPERATURE AND HUMIDITY MEASUREMENT

Transducers for Temperature Measurement- non- electrical and electrical method, Bimetallic Thermometer, Resistance Thermometer like RTD, Thermistor and Thermocouple, Radiation and Optical Pyrometer, Measurement of Humidity and Moisture - basic definitions, psychometric method

#### **UNIT IV: STRAIN AND PRESSURE MEASUREMENT**

Strain Gauges- strain measurement technique, resistance strain gauge and its types, Signal conditioning of strain gauges, Transducers for Measurement of Pressure: - Manometers types (like Single column, inclined, U-tube), Mechanical Types (Bourdon, bellows and diaphragm), Elastic Types transducers, Low Pressure measurement gauges (Ionization, McLeod etc.)

#### **UNIT V: FLOW AND LEVEL MEASUREMENT**

Transducers for Measurement of Flow: - Types of flow meters, Theory of variable head constant area meter, theory of constant head variable area meter and its types, theory of variable head variable area meter and its types, Special flow meters- Electromagnetic, Hot wire Anemometer, Turbine meter and Ultrasonic flowmeter. Transducer for Level Measurement: - direct and indirect method, resistive method, Ultrasonic, Capacitive level Gauges

#### **Course Outcomes:**

CO.No.	CO
CO1	Understand the fundamental principles, terminologies of various types of sensors including thermal, mechanical, electrical, electromechanical and optical sensors.
CO2	Classify and explain various sensor elements for different applications
CO3	Set strategies for the selection and installation of suitable sensing elements
CO4	Predict the performance characteristics of various sensors based on standards and guidelines
CO5	Integrate sensing elements in the development of measurement systems

#### **Books Recommended:**

- [1] Ernest O. Doebelin, "Measurement Systems Application and Design", 5/e, Tata McGraw –Hill Publishing Company Ltd., 2004
- [2] Albert D. Helfrick & William D. Cooper, "Modern Electronic Instrumentation and measurement Technique", Low Price Edition, Pearson Education, 2005
- [3] A.K. Sawhney & Puneet Sawhney, "A Course in Electrical and Electronic measurements and Instrumentation", 7/e, Dhanpat Rai & Co.(P) Ltd.,2005
- [4] DVS Murthy, "Transducers and Instrumentation", PHI 2nd Edition 2013
- [5] Patranabis D, "Sensors & Transducers", Wheeler, 1996.
- [6] D.S.Kumar, Mechanical Measurements and Control, 3/e, Reprint-2004, Metropolitan Book Co. Private Ltd.,2004
- [7] B. G. Liptak, "Instrumentation Engineers Handbook (Measurement)", CRC Press, 2005.

### **CO-PO-PSO Relationship**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2	PSO 3
4REPC2.CO1	3	3	2	2	2	–	–	–	–	1	–	2	2	2
4REPC2.CO2	3	2	3	2	2	–	–	–	–	1	–	3	3	2
4REPC2.CO3	3	3	2	2	2	–	–	–	–	1	–	3	3	2
4REPC2.CO4	3	3	3	3	2	–	–	–	–	1	–	3	3	2
4REPC2.CO5	2	2	3	3	3	–	–	–	2	3	2	3	3	3

#### **List of Experiments:**

1. To determine strain using full bridge and half bridge
2. To study the characteristics of RTD (PT-100)
3. To study the characteristics of thermistor temperature transducer.
4. To study the characteristics of Thermocouple of J and K type
5. To study the characteristics of bimetallic Relay
6. To study the characteristics of LDR (Light dependent Resistor)
7. To study the characteristics of Photovoltaic cell /solar cell
8. To study the characteristics of LVDT
9. To study the characteristics of Inductive Transducer
10. To study the characteristics of Hall effect sensor

