

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

COs	CO Statements
CO1	Classify different Sensors & Actuators based on various physical phenomena and differentiate their performance characteristics
CO2	Analyze the working principles of thermal, optical & electric sensors and actuators to interpret their mathematical model
CO3	Interpret the functional principles of magnetic, thermal & Chemical sensors and actuators to interpret their mathematical model
CO4	Select the relevant sensors and actuators to design real-time data acquisition from ambience via case studies

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Answer ALL Questions

(10 X 10 = 100 Marks)

1. Explain the different ways sensors can be classified based on different criteria. CO1 BL2
2. Explain the working principle of a Thermocouple based on the Seebeck Effect. Mention its merits, demerits and applications. CO2 BL2
3. A Pt100 RTD with resistance $100\ \Omega$ at 0°C and temperature coefficient $\alpha = 0.00385 / ^\circ\text{C}$ is used in a Wheatstone bridge circuit. The bridge has three fixed resistors each of $100\ \Omega$ and is excited with a 10 V DC supply. CO2 BL3
 - I. Determine the resistance of the RTD at 75°C .
 - II. Calculate the bridge output voltage at this temperature assuming a simple Wheatstone bridge configuration.
 - III. Determine the sensitivity of the bridge output voltage with respect to temperature around 75°C .

Assume the RTD follows the relation:

$$R_t = R_0(1 + \alpha T)$$
4. Explain the operating principle of phototubes and photomultiplier tubes and compare their performance. CO2 BL2

5. Describe the working principle of a CCD for image sensing and explain how two-dimensional charge scanning is performed. CO2 BL2
6. Describe various configurations of capacitive sensors. CO3 BL2
7. Output of a Linear Variable Differential Transformer is connected to a 5 V voltmeter through an amplifier having a gain of 250. When the core of the LVDT moves through a displacement of 0.5 mm, an output voltage of 2 mV appears across the terminals of the LVDT. Determine the sensitivity of the LVDT and the sensitivity of the entire measurement system. The millivoltmeter used in the setup has a scale with 100 divisions, and the scale can be read up to 1/5 of a division. Calculate the resolution of the instrument in millimeters. CO3 BL4
8. Explain the construction and working principle of a solenoid valve and mention its applications. CO3 BL2
- 9.a) Discuss the working mechanism of a strain gauge and obtain the expression for gauge factor. CO3 BL2
- OR
- 9.b) Discuss the working mechanism of a piezoelectric sensor and derive the relationship between mechanical stress and the electrical output. CO3 BL2
- 10.a) Suggest a suitable sensor for measuring the distance of an object without contact and explain its working principle. CO4 BL2
- OR
- 10.b) Suggest a suitable sensor for pH measurement in industrial processes and explain its principle of operation. CO4 BL2

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