

Name(s) : BCSE311L and Sensors and Actuator Devices
 Class Number(s) : Common for all
 Date of Examination : Common for all
 Exam Duration : 28.01.2025
 General instruction(s): : 90 minutes

Maximum Marks: 50

- Answer All Questions
- M - Max mark; CO - Course Outcome; BL - Blooms Taxonomy Level (1 - Remember, 2 - Understand, 3 - Apply, 4 - Analyse, 5 - Evaluate, 6 - Create)
- 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.

Q. No	Question	M	CO	BL
1.	Investigate the following terms precisely based on given criteria:- ➤ Vision ➤ Touch Given Criteria: ★ What ★ Why ★ How ★ Where ★ When Based on your investigation, analyze whether the loss of vision or touch would create more challenges and issues. Provide enough justifications with real life scenarios. Note: - You should narrate complete investigation as well as suitable real-life sub-scenarios for vision & touch in your answer.	10	CO 1	B L 3
2.	Elucidate using a real life scenario how calibration and reliability plays a major role in choosing sensors for any critical application. A temperature sensor is calibrated using a reference temperature of 150°C. During the calibration, the sensor gives a reading of 154°C. The sensor has a measurement range of 0°C to 240°C with a specified accuracy of $\pm 2^\circ\text{C}$ and a drift rate of 0.6% per year and is cumulative every year. ✓ What is the calibration error in terms of percentage error relative to the reference temperature? ✓ Calculate the reliability of the sensor after 12 years, considering the drift rate. ✓ Compute the sensor's output if the actual temperature is 160°C for year 3, 6, 9, 12, 15. ✓ Plot a graph for year vs sensor output and state your observations. Suggest remedies to reduce calibration errors.	10	CO1	B L 2



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CONTINUOUS ASSESSMENT TEST - I
WINTER SEMESTER 2024-2025

SLOT: B1+TB1

3.	Explain the effect of sensor non-linearity on the accuracy and reliability of measurements. How does non-linearity impact systems that require precise control, such as industrial automation or temperature monitoring? Discuss methods to compensate for non-linearity and improve sensor performance.	10	C01	B L 2
4.	Provide a in-depth analysis with detailed explanation for the following sensors by applying the given terms:- • Optical thermo-mechanical Sensors • Acoustical thermo-mechanical Sensors Given terms: ➤ Sensitivity and Accuracy ➤ Speed of Response ➤ Environmental Effects ➤ Energy Efficiency ➤ Application selectivity Design and develop a data acquisition system using your analysis as per the guidelines:- ✓ Scenario – post earthquake ✓ Need to schedule unmanned rescue cart ✓ Highest priority for rescuing live people trapped inside the collapsed structures Note: - You must provide appropriate illustrations, sensors and actuator selection as well as relevant validations in your answer.	10	C02	B L 3
5.	A spool of magnet wire (copper wire insulated with a thin layer of polyurethane) contains 400 m of wire with a diameter of 0.2 mm. It is proposed to use the spool as a temperature sensor to sense the temperature in a freezer. The proposed range is between- 50°C and +15° C. A milliammeter is used to display the temperature by connecting the sensor directly to a 1.2 V battery and measuring the current through it. [conductivity as $\sigma_0 = 5.8 \times 10^7$ S/m at 20° C TCR of copper $\alpha = 0.0039$] • Calculate the resistance of the sensor and the corresponding currents at the minimum and maximum temperatures. • Calculate the maximum power the sensor dissipates. • Discuss various factors that influence the response time of a Resistance Temperature Detector (RTD).	10	C02	B L 2
