VIT
Vellore Institute of Technology

Course: BCSE311L
Class NBR(s): 3466 / 3467
Time: Three Hours

Assessment Test – April 2026
Sensors and Actuator Devices

Slot: D2
Max. Marks: 100

- 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. Describe the following static characteristics of a measurement system with example. **CO1 BL2**
   i. Range ii. Span iii. Resolution iv. Accuracy v. Precision

2. A force sensor has the following characteristics: **CO1 BL3**

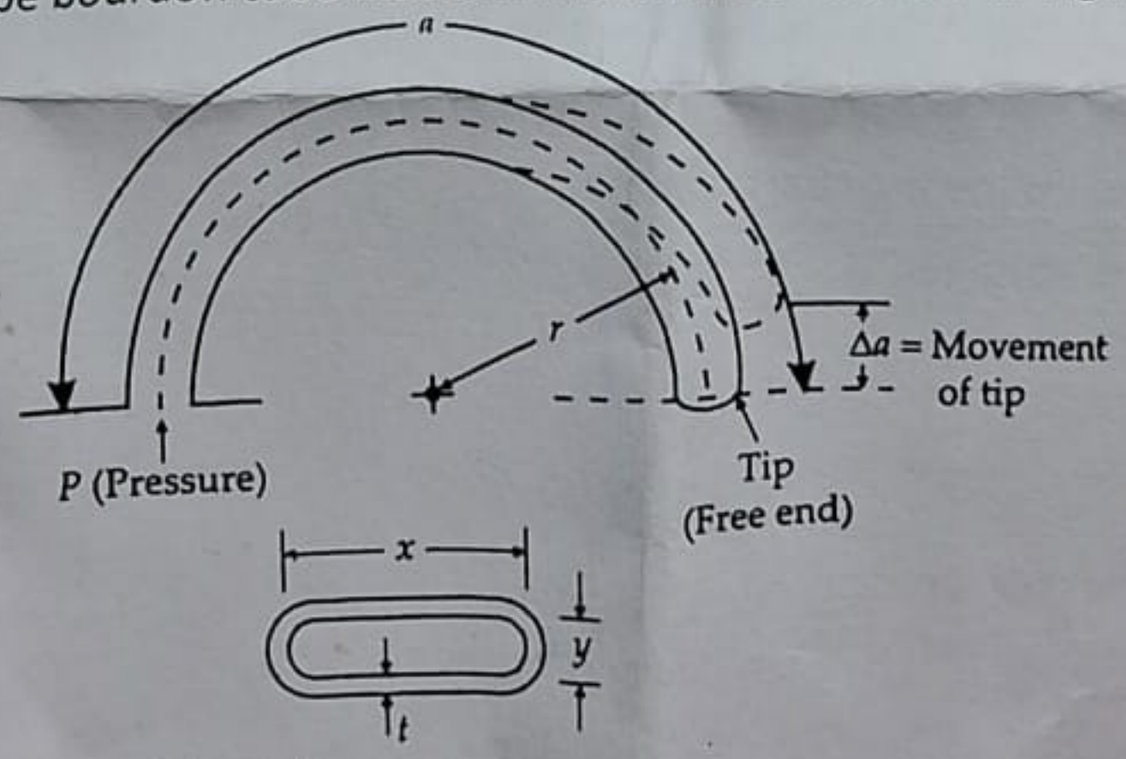
Force (N)	Output Voltage (V)
0	0.5
500	4.5

   Determine
   i. Transfer function of the sensor ii. Sensitivity
   iii. Span of the sensor iv. Output voltage at 250 N

3. Describe the construction and working of resistance thermometer. Describe the materials used for RTDs, and sketch their typical characteristics. **CO2 BL2**

4. A thermistor has a resistance of 3980 Ω at the ice point (0°C) and 794 Ω at 50°C. The resistance temperature relationship is given by $R_T = aR_0\, e^{b/T}$. Calculate the constants a and b. **CO2 BL3**
   Calculate the range of resistance to be measured in case the temperature varies from 40°C to 100°C.
   [Note: R_T, R_0 are resistance of thermistor at temperature T°K and ice point respectively]

5.	Explain the constructional details and working of a photo-voltaic cell. Why is it very useful for space applications?		CO2	BL2
6.	Describe the construction and working of optical liquid level sensor with neat diagram to collect real–time corrosive liquid level.		CO2	BL3
7.	Explain the different principles of working of capacitive transducers.		CO3	BL3
8.	Explain the working principle of a DC motor using Fleming's Left-Hand Rule. How does direction of rotation change when: i) Armature current is reversed? ii) Field polarity is reversed?		CO3	BL2
9.a)	Compare the resistance change produced by a strain of 150 microstrain if a strain gauge of nominal resistance of 120 Ω is used (i) when made of wire resistance having a gauge factor of 2.13 and (ii) when made of a semiconducting material having a gauge factor of 151.		CO3	BL3
	OR			
9.b)	i) An accelerometer has a seismic mass of 0.05 kg and a spring constant of 3×10^3 N/m. Maximum mass displacement is ± 0.02 m (before the mass hits the stop). Calculate a. maximum measurable acceleration and b. natural frequency.	[5]	CO3	BL4
	ii) A C type bourdon tube made of Monel metal is show in Figure.	[5]		



The dimensions of the tube are:

$r = 36.5\ mm$, $x = 16\ mm$, $y = 3\ mm$, $t = 0.35\ mm$

Calculate the displacement of the free end if a pressure of 1500 kPa is applied. The modulus of elasticity for Monel metal is 180 GN/m².

10.a)	Identify a suitable sensor for car reverse parking assistance system and explain how the system detects obstacles with suitable diagram.		CO4	BL2
	OR			
10.b)	Perform a case study on a system for monitoring water quality. Describe the sensors used and working of water quality monitoring system.		CO4	BL2

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