

# International Institute of Information Technology Bangalore

Dept. of Electronics and Communication Engineering

## VLS512 - Sensors and signal conditioning circuits

### Assignment - 1

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1. Consider a system that measures the force of exerted over a resistive sensor as shown in Fig. 1. The sensor's resistance varies by  $2\ \Omega$  when subjected to a change in force of 10 N. The circuit quantifies this change in resistance ( $\Delta R$ ) through voltage, expressed as  $\Delta V = \Delta R/10$ . Determine the sensitivity of;
- a) Sensor b) Circuit.

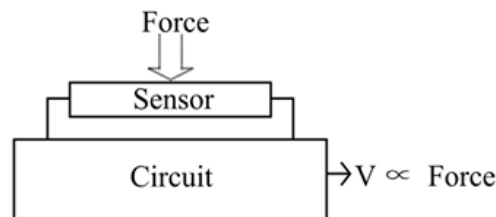


Fig. 1

2. A temperature sensor initially reads  $50^{\circ}\text{C}$  for a constant input. After 2 hours, it reads  $52^{\circ}\text{C}$  without any change in input. Calculate the Drift in  $^{\circ}\text{C}$  and also the % Drift.
3. The expected value of voltage to be measured is 150 V. However, the measurement gives a value of 149 V. Calculate
- (i) Absolute error
  - (ii) Relative percentage error in reading
  - (iii) Percentage error in full-scale if the scale range is 0 – 200 V.
4. A voltmeter gives the following readings for a constant input voltage: 10.02 V, 9.98 V, 10.01 V, 9.99 V, 10.00 V.
- a. Determine the best value of measurement
  - b. Determine the Standard deviation in measurement
5. A current of 2 A DC is to be measured. Which one of the following PMMC ammeters you would choose and why?
- (a) 0 – 5 A, class 0.5
  - (b) 0 – 3 A, class 1.0.
6. The total Voltage  $V = V_1 + V_2 + V_3$  is measured as,  $V_1 = (10 \pm 0.25)\text{ V}$ ,  $V_2 = (2 \pm 0.15)\text{ V}$  and  $V_3 = (5 \pm 0.5)\text{ V}$ . Then what will be the value of voltage V measured? What will be %error in measuring Voltage V?

7. Consider a voltmeter measures the voltage across a charged capacitor as  $V_C = 5 \text{ V}$  with error in reading of 2.5 %, whose capacitance measured by an LCR meter is given as  $C = 30 \text{ pF}$  with error in reading of 0.5 %. Then determine error in calculating charge stored in the capacitor.
8. For an input of  $70^\circ\text{C}$ , a temperature measurement instrument gives:  
Output (increasing input): 7.25 V  
Output (decreasing input): 6.85 V  
For the same input, repeated measurements vary between 7.28 V and 7.18 V. Also, the output range of the instrument is **0–10 V**, corresponding linearly to a temperature range of **0–100 °C**. Then calculate:  
a. Hysteresis error (% FS)  
b. Repeatability error (% FS)  
c. Systematic error (% FS)
9. A linear temperature sensor has:  
Initial sensitivity = 5 mV/°C  
Zero output = 100 mV at  $0^\circ\text{C}$   
After 10 hours:  
Zero drift = +8 mV  
Sensitivity drift = -2%  
For an actual temperature of  $60^\circ\text{C}$ :  
a. Calculate initial output  
b. Calculate output after drift  
c. Determine the measurement error in  $^\circ\text{C}$
10. In a Wheatstone bridge, the voltages across the two adjacent arms of the bridge are measured with a 5 V, class 0.5 meters as 3.6 and 3.5 V and the difference voltage is then computed. Determine the percentage error in computation.

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