

VLS512 - Sensors and signal conditioning circuits
Assignment - 1

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 2Ω when subjected to a change in force of 10 N. The circuit quantifies this change in resistance (ΔR) through voltage, expressed as $\Delta V = \Delta R/10$. Determine the sensitivity of;
a) Sensor b) Circuit.

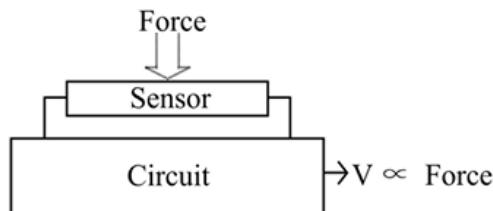


Fig. 1

2. A temperature sensor initially reads 50°C for a constant input. After 2 hours, it reads 52°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, $V_1 = (10 \pm 0.25)$ V, $V_2 = (2 \pm 0.15)$ V and $V_3 = (5 \pm 0.5)$ 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 $V_C = 5$ V with error in reading of 2.5 %, whose capacitance measured by an LCR meter is given as $C = 30$ pF with error in reading of 0.5 %. Then determine error in calculating charge stored in the capacitor.
8. For an input of 70 °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:
- Hysteresis error (% FS)
 - Repeatability error (% FS)
 - Systematic error (% FS)
9. A linear temperature sensor has:
- Initial sensitivity = 5 mV/°C
Zero output = 100 mV at 0°C
- After 10 hours:
- Zero drift = +8 mV
Sensitivity drift = -2%
- For an actual temperature of 60°C:
- Calculate initial output
 - Calculate output after drift
 - Determine the measurement error in °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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