

This question paper contains 4 printed pages]

Roll No.

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

S. No. of Question Paper : 7991

Unique Paper Code : 2511202

F-II

Name of the Paper : Transducer [DC-1.3]

Name of the Course : B.Tech. Instrumentation

Semester : II

Duration : 3 Hours

Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt Five questions in all.

Question No. 1 is compulsory.

1. (a) Define sensitivity. Why are sensitivity and linearity in potentiometers conflicting performance parameters ? 3
- (b) Name the type of transducer in which : 3
 - (i) Measurand is temperature and output variable is voltage
 - (ii) Measurand is force and output variable is resistance change
 - (iii) Measurand is pressure and output variable is displacement.
- (c) Write five desirable characteristics of a transducer. 3
- (d) A voltmeter has an accuracy of $\pm 1\%$ of FSD having a range of 1000 V. If a true value (TV) reading is 100 V, what would be the range in which the voltmeter will give reading ? 3
- (e) Compare the following : 3
 - (i) Reproducibility and Repeatability
 - (ii) Dynamic and static performance characteristics.

P.T.O.

2. (a) Draw a functional block diagram of a Bourdon tube and explain the function of each block. 5
- (b) In a Wheatstone bridge, a strain gauge is being used as a Quarter Bridge. Derive the relation between gauge factor and change in output voltage when the bridge is unbalanced. 5
- (c) A single strain gauge having resistance of 120Ω is mounted on a steel cantilever beam at a distance of 0.15 m from the free end. An unknown force F applied at the free end produces a deflection of 12.7 mm of the free end. The change in gauge resistance is found to be 0.152Ω . The beam is 0.25 m long and has a width of 20 mm and depth of 3 mm. The Young Modulus for steel is 200 GN/m^2 . Calculate the Gauge factor. 5
3. (a) State and prove what happens to the sensitivity of a capacitive transducer : 5
- (i) when area between the plates of the capacitor changes
- (ii) when distance between the plates of the capacitor changes.
- (b) The dead zone of a pyrometer is 0.125% of the span. The calibration is 800°C to 1800°C . What temperature change must occur before it can be detected by the pyrometer ? 3
- (c) Explain the working and principle of an LVDT. Also draw the plot showing variation in amplitude and phase of the output with displacement. 7

4. (a) A voltmeter with internal resistance of $200\text{ K } \Omega$ is connected across an unknown resistance. It reads 250 V and the milli ammeter connected in series with the same resistance reads 10 mA . Determine the apparent resistance, actual resistance and the loading error due to the loading effect of the voltmeter. 6
- (b) What does the polarity of the Hall effect voltage indicate ? Explain *two* applications of Hall effect as sensors. 5
- (c) Which are the various modes of operation of Piezo-electric Crystals ? 4
5. (a) Which temperature transducer of the following gives most linear characteristics :
- (i) Thermocouple
- (ii) RTD
- (iii) IC sensor.
- Name *three* types of characteristics observed in a thermistor and give their brief explanation. 1+5
- (b) What is the common name by which Photovoltaic transducers are known as ? Explain their working and draw their characteristic plot. 4
- (c) A platinum thermometer has a resistance of $100\text{ } \Omega$ at 25°C . Find its resistance at 65°C if the platinum has a resistance temperature coefficient of $0.00392/^\circ\text{C}$. If the thermometer then has a resistance of $150\text{ } \Omega$, calculate the temperature. 5
6. (a) State *two* advantages and disadvantages each of semiconductor strain gauges. 4

- (b) The impedance of a RL circuit operating on alternating current is given by :

$$Z = \sqrt{R^2 + L^2\omega^2},$$

where R is 100 Ω with an uncertainty of 5%, L is known to be 2H with an uncertainty of 10% and $\omega = 2\pi \times 50$. Determine the uncertainty in measurement of Z. 6

- (c) What do you understand by the precision of an instrument ? Draw a comparison between accuracy and precision. The output voltage of an amplifier was measured at eight different intervals using the same digital multimeter with the following results :

20.00, 19.80, 19.85, 20.05, 20.10, 19.90, 20.25, 19.95 V.

What is the precision of the third measurement ? 5

7. (a) The output of a LVDT is connected to a 5 V voltmeter through an amplifier whose amplification factor is 250. An output of 2 mV appears across the terminals of LVDT when the core moves through a distance of 0.5 mm. If the multimeter has a 100 divisions and the scale can be read to a 1/5 of a division. Calculate :

(i) Sensitivity

(ii) Resolution of the instrument in mm. 5

- (b) Explain *one* desirable and undesirable dynamic characteristic of instrumentation system. 5

- (c) What are force summing devices ? Briefly explain any *three*. 5