Time: 3 Hours

Note: Attempt any five questions. Question no. 1 is compulsory. Make suitable assumption if needed.

1. (A) Derive the expression of gauge factor for strain gauges. 5

(B) Differentiate between: 15

a) RTD and Thermistor
b) Bonded metal wire and bonded metal foil strain gauges
c) Line and End Standards
d) Tolerance and Allowance
e) Hole basis and Shaft basis systems of fit

(C) Explain the principle and working of following instruments with figures 20

a) Liquid in glass thermometer
b) Micromanometer
c) McLeod gauge
d) Proving rings
e) Pneumatic load cell

2. (A) Explain the principle and working of LVDT with figure. Write the applications of it. 5

(B) What are the desirable properties of liquid used in glass thermometer? Write name of any two such liquids. 5

(C) Describe any one method of temperature compensation for strain gauges. 5

3. (A) A resistance displacement transducer with a shaft stroke of 25 mm is applied to the circuit as shown in Fig. 1. The applied voltage is 10 V. What is the displacement indicated for each of the voltage readings 5.0 V? Assume that the resistance of output device R_m is infinite. 5

(B) A metallic strain gauge has a resistance of 120 Ω and a gauge factor of 2. It is installed on an aluminium structure which has a yield point stress of 0.2 GN/m^2 and Young's modulus of 68.7 GN/m^2, determine the change in resistance of the gauge that would be caused by loading the material to yield point. 5

(C) A manometer uses transformer oil of specific gravity 0.864 as measuring liquid. The scale is graduated in mm of water. If one leg is a 2 mm bore tube and other a 20 mm well, calculate the angle to the horizontal at which the tube and scale must be inclined to give 4 mm scale deflection for a pressure of 1 mm head of water. Assume 1 mm of water = 9.81 Pa. 5

4. (A) A strain bridge (Fig. 2) uses a strain gauge of 120 Ω. The fixed resistors have 120 Ω resistance. Find the bridge output voltage for a supply voltage of 3 V when the strain gauge is subjected to 600 microstrain. Gauge factor of the strain gauge is 2.2. 5

(B) A platinum resistance thermometer has a resistance of 150 Ω at 0 °C. What is the resistance when the temperature is 200 °C? When the thermometer has a resistance of 400 Ω. what is the value of the temperature? The resistance temperature co-efficient of platinum is 0.0039 /°C. 5

(C) A bimetallic strip is constructed of strips of yellow brass and Invar bonded together at 30 °C. Each has thickness of 0.3 mm. Calculate the radius of curvature when a 60 mm strip is subjected to a temperature of 100 °C. One end of the bimetallic strip is fixed. The thermal coefficient of expansion of yellow brass and Invar are respectively 20.2 × 10^{-6}/°C and 1.7× 10^{-6}/°C and their modulus of elasticity are respectively 96.5 GPa and 147 GPa. 5

Determine the tolerances on the hole and shaft for a fit designated by 50 *H7 g6*. Size 50 mm lies between the range 30-50 mm. Fundamental deviation of g shaft is - 2.5 $D^{0.34}$. The values of standard tolerances for grades *IT 6* and *IT 7* are *10i* and *16i* respectively. State the actual maximum and minimum sizes of both hole and shaft and maximum and minimum clearances. Also, indicate the limits and tolerances on a diagram. 15

6. (A) Interpret the meanings of the following fits. 5
(i) *H7f6*, (ii) *H7r6*, (iii) *H7v5*, (iv) *H7h6*, (v) *H7s6*

(B) Explain selective assembly with the help of example. 5

(C) State and explain the Taylor's principle of gauge design. 5

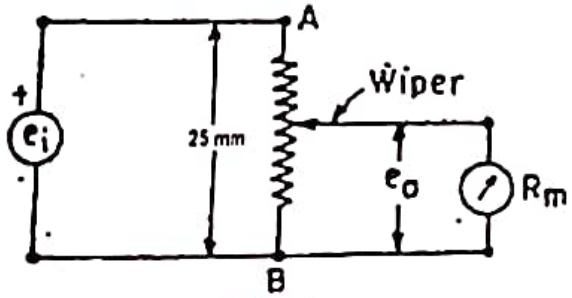
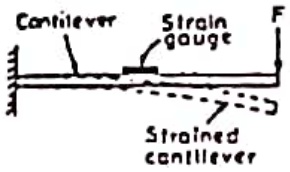


Figure: 1



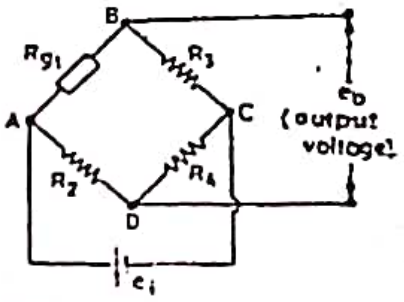


Figure: 2