

- N.B.** (1) Question No.1 is compulsory.
 (2) Attempt any four questions from remaining six questions.
 (3) Assume additional data if necessary.
 (4) Figures to the right indicate full marks.
 (5) Support your answers with neat sketches wherever necessary.

1. (a) A differential pressure gauge is used for measuring vacuum pressure and is made of steel diaphragm. Find the thickness of the diaphragm if the maximum deflection is limited to one third of its thickness. Also calculate the natural frequency of the diaphragm; for the given data :— 4
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|-----------------------|---|-----------------------------------------|
| Diameter | = | 150 mm |
| Modulus of elasticity | = | 200 GN/m ² |
| Poisson's ratio | = | 0.29 |
| Density of steel | = | 7.8 × 10 ³ kg/m ³ |
| Atmospheric pressure | = | 1 × 10 ⁵ N/m ² |
- (b) A strain gauge is bounded to 0.1 m long has a cross sectional area 4 cm², E = 207 GN/m² (Young's modulus of elasticity). Strain gauge has unstrained resistance = 240 Ω and G_T = 2.2. 4
 When load is applied the resistance of gauge changes by 0.013 Ω. Calculate change in length and amount of force applied to beam.
- (c) A temperature measuring device consists of a transducer, an amplifier and pen recorder. Their static sensitivities are, 4
- | | | |
|------------------------------------|---|------------|
| Temperature Transducer Sensitivity | = | 0.25 mV/°C |
| Amplifier gain | = | 2.0 V/mV |
| Recorder sensitivity | = | 5 mm/V |
- How much displacement will be shown by the recorder for a 1°C change in temperature ?
- (d) While measuring speed of a steam turbine with a stroboscope, stationary images were observed for three consecutive stroboscope setting of 3000, 4000 and 5250 flashes per minute. Calculate the rotational speed of turbine. 4
- (e) A platinum resistance thermometer has a resistance of 1000 Ω at 0°C. The thermometer is connected to a Wheatstone Bridge, with the others arms having resistance of 1000 Ω each. The source voltage to the bridge is 12 V. When the thermometer is subjected to an unknown temperature, the voltmeter which measures the bridge output, indicates the reading of 720mV. Determine the unknown temperature. The constant of the platinum resistance thermometer is 0.18 Ω / °C. 4
2. (a) Define and explain the following terms :— 10
- (i) Threshold and Resolution
 - (ii) Sensitivity and Drift
 - (iii) Hysteresis.
- (b) Write short notes on :— 10
- (i) Bridgman's Gauges
 - (ii) Thermal Conductivity Gauges.

Con. 5313-SP-8502-09.**2**

3. (a) The average power transmitted by a rotating shaft is found out by using a dynamometer where the following specific measurements were made. The horsepower is calculated using the formula :— **10**

$$HP = \frac{2\pi nFL}{750t}$$

Where,

n	=	Rotation in t secs	=	1202 ± 1 revolution
F	=	Force at end of the torque arm	=	50 ± 0.2 N
L	=	Length of torque arm	=	0.335 ± 0.001 m
t	=	60.00 ± 0.5 secs	=	time

Calculate nominal HP and its limiting error in the computed power.

- (b) Compare the thermoelectric sensors on the basis of basic principle of working, materials used, characteristic behaviour, range of operation and their types available. **10**
4. (a) Explain :— **10**
- Non-contact type of speed measurement
 - Working of strain gauge type of accelerometer.
- (b) Define strain gauge. Explain different types of strain gauge. What is gauge factor? Why temperature compensation is needed in strain measurement? Explain any one method of temperature compensation. **10**
5. (a) Explain the different principles of working of capacitive transducer. Also discuss advantages, disadvantages and uses of capacitive transducer. **12**
- (b) Explain the three wire method for checking the pitch diameter of screw. **8**
6. (a) Explain use of slip gauges. Show a setup for the measurement of cone angle of a taper plug gauge by a sine bar. **10**
- (b) State the principle of operation of a comparator. Explain the principle of pneumatic comparator. **10**
7. Write short notes on the following :— **20**
- Significance of Mechanical Measurement
 - The optical system of an auto-colimator
 - Elements of Surface Roughners
 - Interchangeability and its importance
 - Calibration of pressure sensor.
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