



Name :
Roll No. :
Invigilator's Signature :

CS/B.TECH(EE)/SEM-8/EE-802B/2012

2012

SENSORS AND TRANSDUCERS

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

10 × 1 = 10

- i) Thermo-electric effect was first observed by
 - a) Seebeck
 - b) Thomas Young
 - c) Peltier
 - d) Thermus.

- ii) The most suitable device for measuring temperature of furnace is
 - a) RTD
 - b) thermistor
 - c) optical pyrometer
 - d) bimetallic thermometer.



iii) Capacitive transducers are normally employed for measurement of

- a) static
- b) dynamic
- c) both (a) and (b)
- d) transient.

iv) Dummy strain gauges are used for

- a) calibration of strain gauges
- b) compensation of temperature
- c) increasing bridge sensitivity
- d) all of these.

v) High value POT resistance leads to

- a) low sensitivity
- b) high sensitivity
- c) low non-linearity
- d) less error.

vi) Piezoelectric crystals are used for measurement of changes.

- a) static
- b) dynamic
- c) both (a) and (b)
- d) any of these.



vii) A thermocouple

- a) has a low time constant when it is bare
- b) has a low time constant if it is provided with a sheath
- c) has the same time constant whether it is bare or provided with a sheath
- d) none of these.

viii) Electrical resistance of thermistor

- a) increases as the temperature increases
- b) decreases as the temperature increases
- c) remains unaffected with the change in temperature
- d) increases at low temperature and decreases at high temperature.

ix) Self generating type transducers are transducers.

- a) active
- b) passive
- c) secondary
- d) inverse.



- x) Residue voltage occurs due to
- a) harmonics and stray capacitance
 - b) creeping error
 - c) hysteresis loss
 - d) eddy current loss.
- xi) Which one of the following is passive transducer ?
- a) Thermocouple
 - b) Strain gauge
 - c) Thermopile
 - d) Photovoltaic cell.
- xii) The gauge factor of semiconductor strain gauge is high than the ordinary metal wire resistive strain gauge because of
- a) Piezo-resistive effect
 - b) temperature effect
 - c) Zener breakdown
 - d) its small size.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Describe the basic principle of a Hall Device. Show how it can be used as magnetic field sensor.



3. a) A platinum thermometer has a resistance of 100 ohm at 25° C. Find the resistance at 65° C if the platinum has a resistance temperature coefficient of 0.00392/°C.

b) Comment on the linearity and sensitivity of transducer.

2 + 3

4. What do you mean by gauge factor ?

A resistance wire strain gauge with a gauge factor of 2 is bonded to a steel structure subjected to a stress of 100 MN/m². The modulus of elasticity of that structure is 200 GN/m². Calculate the percentage change in the value of the gauge resistance due to the applied stress.

5. a) Enumerate the different sources of error in a capacitive type transducer.

b) Explain how angular displacement can be measured with the help of a gang capacitor. 2 + 3

6. a) Describe the schematic diagram of the magnetostrictive force transducer.

b) Describe the Radiation Pyrometer. 2 + 3



GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Explain the operation of an LVDT with suitable diagrams.
- b) An output of an LVDT is connected to a 4V voltmeter through an amplifier whose amplification factor is 500. An output of 1.8 mV appears across the terminals of LVDT when the core moves through a distance of 0.6 mm. If the millivoltmeter scale has 100 divisions and the scale can be read to $\frac{1}{4}$ of a division, calculate (i) the sensitivity of the LVDT, (ii) the resolution of the instrument in mm. $5 + 10$
8. How can strain developed on strain gauge be measured by using full-bridge configuration ? Derive the sensitivity relation between Quarter-bridge, Half-bridge and Full-bridge configurations of strain gauge measurement. What is dummy gauge ? $4 + 4 + 5 + 2$
9. State the working principle of Thermocouple. Mention name along with their temperature range and composition of two commonly used thermocouple. Name two IC type temperature sensors. Explain any of them with circuit diagram. $5 + 2 + 2 + 6$



10. Describe the different principles of working of capacitive transducers. Mention some advantages and disadvantages of capacitive transducer. What is Piezoelectric effect ? What are the materials used for Piezoelectric transducer ? 9 + 4 + 1 + 1
11. Write short notes on any *three* of the following : 3 × 5
- a) LVDT
 - b) RTDs
 - c) Piezoelectric Effect
 - d) Bounded & Unbounded Strain Gauge
 - e) Smart Sensors.

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