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MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

Paper Code : EE-802B

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 : $10 \times 1 = 10$

   i) Dummy strain is used
   - a) to increase sensitivity
   - b) to measure tensile strain
   - c) for temperature compensation
   - d) to measure compressive strain.

   ii) ..... is an active transducer.
   - a) RTD
   - b) Strain gauge
   - c) Thermocouple
   - d) LVDT.

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   iii) Gauge factor of a strain gauge indicates its
   - a) accuracy
   - b) sensitivity
   - c) dead zone
   - d) none of these.

   iv) Capacitive transducers are normally used for
   - a) static measurement
   - b) dynamic measurement
   - c) both (a) and (b)
   - d) transient measurement.

   v) Piezoelectric transducer can be used as
   - a) Force sensing element
   - b) Strain sensing element
   - c) Torque sensing element
   - d) None of these.

   vi) Hall effect transducers are used to measure
   - a) magnetic field
   - b) electric field
   - c) current
   - d) both (a) and (c).

   vii) Rochelle salt belongs to
   - a) natural group of piezoelectric
   - b) synthetic group of piezoelectric
   - c) both (a) and (b)
   - d) none of these.

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viii) Piezoelectric transducer is a/an

a) passive transducer b) active transducer

c) inverse transducer d) both (b) and (c).

ix) Which of the following is digital transducer ?

a) Thermistor b) LVDT

c) Encoder d) RTD.

x) Which type of thermocouple is used to measure a temperature of 1400°C ?

a) Type *R* b) Type *K*

c) Type *J* d) Type *E*.

xi) Residue voltage due occurs due to

a) Harmonics and stray capacitance

b) Creeping error

c) Hysteresis loss

d) Eddy current loss.

xii) The resistance of a resistance strain gauge (bonded type) is of the order of

a) 5 Ω b) 50 Ω

c) 120 Ω d) 0·5 Ω.

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GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. What are the materials of thermo EMF Sensors ? What is longitudinal piezoresistance coefficient in connection with strain gauges ?

3. Explain the working principle of LDR. What is photo-multiplier ?

4. What are PZT and PLZT ? Why are they gaining importance in sensor technology ?

5. What are the differences between Villari effect and Wiedemann effect ? How are these effects used in developing magneto-elastic sensors ?

6. What do you mean by the terms "Accuracy", "Precision" and "Resolution" in case sensors having static characteristics ?

7. What is the difference between vacuum deposition processes in strain gauge ? What are the important properties necessary for bonding materials ?

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8. How does gauge factor of a semiconductor strain gauge vary with doping level ? Discuss with the help of diagram.

GROUP – C

(Long Answer Type Questions)

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

9. a) What is Seebeck effect ? How does it develop and how has it been commercially exploited ?

   b) What different material-pairs are used for making commercial thermo emf generators ? How are they designated ?

   c) What are MI thermocouples ? What special advantages do these thermocouples have and what are their disadvantages ? 5 + 5 + 5

10. a) What are the different types of inductive sensors ? How is displacement measured by such sensors ? How does the inductance change in such a system ?

    b) A core having 20 single turn coil and a magnetic path length, including an armature of 10 cm, has a cross-section area of 1·2 sq.cm. For a displacement to be measured, the gap length changes from 0·1 cm to 0·15 cm. By what percentage does the inductance of the coil and for what original inductance value ? Assume a core permittivity of 10·5. 7 + 8

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11. a) How the capacitive transducer can be used to measure the level of non-conducting liquid ? What special arrangement should be done while measuring conducting fluid ? Also explain the scheme. 2 + 2 + 5

    b) Explain how a capacitive transducer can be used as a microphone. Also draw the frequency response characteristics. 2 + 4

12. a) Describe the constructional details of a resistance potentiometer.

    b) Derive the expression for its output voltage when connected across a meter of finite impedance.

    c) Also derive the expression of error.

13. a) Why is the cold junction compensation necessary for thermocouple ? What is the technique of cold junction compensation ? 2 + 3

    b) Name two IC type temperature sensors. Explain any of them with circuit diagram. 2 + 3

    c) Why is 4 wire RTD more convenient compared to 3 wire RTD ? Explain briefly. 2 + 3

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14. Write short notes on any *three* of the following : 3 × 5

a) Piezoelectric materials

b) Capacitive sensors

c) Photovoltaic and Photojunction cells

d) Ultrasonic Sensor

e) Scintillation Detectors

f) Optical pyrometer

g) Hall effect sensors

h) Magnetostrictive Transducer.

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