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CS/B.TECH/EE/SEM-8/EE-802B/2013

2013

SENSOR 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) An inverse transducer converts

a) mechanical energy to electrical energy

b) electrical energy to light energy

c) electrical energy to mechanical form

d) all of these.

ii) The gauge factor is defined as

a) $\left(\frac{\Delta L}{L}\right)\left(\frac{\Delta R}{R}\right)$ b) $\frac{\left(\frac{\Delta R}{R}\right)}{\left(\frac{\Delta L}{L}\right)}$

c) $\frac{\left(\frac{\Delta R}{R}\right)}{\left(\frac{\Delta D}{D}\right)}$ d) $\frac{\left(\frac{\Delta R}{R}\right)}{\left(\frac{\Delta P}{P}\right)}$

iii) The smallest change in input that a transducer can sense is known as

a) sensitivity

b) resolution

c) precision

d) accuracy.

iv) Gauge factor of a strain gauge indicates its

a) accuracy

b) sensitivity

c) dead zone

d) none of these.

v) The principle of operation of LVDT is based on variation of

a) self inductance

b) mutual inductance

c) reluctance

d) permeance.

vi) Which one of the following is a digial transducer ?

a) Thermistor b) LVDT

c) Encoder d) RTD.

vii) Radiation pyrometers are used in temperature range of

a) 0 to 500°C

b) 500 to 2000°C

c) – 250 to 500°C

d) 1200 to 3000°C.

viii) Load cell is a transducer which measures

a) force b) temperature

c) strain d) pressure.

ix) Residue voltage occurs due to

a) Harmonics and stray capacitance

b) Hysteresis loss

c) Creeping error

d) Eddy current loss.

x) Hall effect transducers are used for measuring

a) magnetic field b) current

c) electric field d) pressure.

xi) Angular velocity is measured by

a) strain gauge

b) solar cell

c) A.C. tacho-generator

d) none of these.

xii) Quartz and Rochelle salt belong to

a) synthetic group of piezoelectric material

b) natural or synthetic group of piezoelectric materials provided properly polarised

c) natural group of piezoelectric materials

d) all of these.

GROUP – B

(Short Answer Type Questions)

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

2. What is piezoelectric transducer ? Give the equivalent circuit. Derive an expresson for the output voltage by making suitable simplifying assumptions. 1 + 1 + 3

3. Explain the operating principle of photodiode. What is photomultiplier ? 3 + 2

4. What is load cell ? Which pyrometer can be measured with it ? Explain working principle. 1 + 1 + 3

5. Explain with example active and passive transducer.

6. Draw the diagram of capacitive microphone. Explain its working principle.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Describe the principle of operation of strain gauge for measurement of strain. 4

   b) What is gauge factor of a strain gauge ? Derive the expression of gauge factor. 2 + 4

   c) How can a dummy gauge be used for temperature compensation for measurement using strain gauge ? 5

8. Describe the basic principle of a hall device. Show how it can be used for magnetic field sensor. How is hall effect transducer utilized for measurement of displacement ?

5 + 5 + 5

9. a) State the working principle of thermocouple. Name two IC type temperature sensors. Explain any of them with circuit diagram. 5 + 5

b) Describe the construction and working principle of resistance thermometer. Describe the materials used for RTDs along with their properties. 5

10. a) What do you mean by Villary Effect and Wiedmann Effect ? 5

b) Describe the working principle of Geiger-Müller counter. 5

c) What are the advantages of IC type sensors over other types of thermal sensors ? 5

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

a) Smart Sensor

b) Proximity Sensor

c) Ultrasonic Sensor

d) LDR

e) Thermistor.