



Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH(EE)/SEP.SUPPLE/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 :

$$10 \times 1 = 10$$

- i) Dummy strain gauge is used
 - a) to increase sensitivity
 - b) to measure tensile strain
 - c) for temperature compensation
 - d) to measure compressive strain.
- ii) The gauge factor of semiconductor strain gauge is in the range of
 - a) 2 to 10
 - b) 100 to 150
 - c) more than 200
 - d) 50 to 100.



iii) Thermocouples are

- a) passive transducer
- b) active transducer
- c) both active and passive transducer
- d) output transducer.

iv) The material which shows magnetostrictive effective is

- a) Force
- b) Flow
- c) Temperature
- d) Displacement.

v) Residue voltage occurs due to

- a) harmonics and stray capacitance
- b) creeping error
- c) hysteresis losses
- d) eddy current losses.

vi) is an active transducer.

- a) RTD
- b) LVDT
- c) Thermocouple
- d) Strain gauge.



xii) Piezoelectric transducer are

- a) Passive transducer
- b) Active transducer
- c) Inverse transducer
- d) both (b) and (c).

GROUP – B

(Short Answer Type Questions)

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

2. What is dummy gauge ? How can it be used for temp compensation ? $2 + 3$
3. Draw the suitable diagram of capacitive microphone and discuss its operation.
4. How will you measure angular velocity using inductive type proximity sensor ? How is the rotational speed in r.p.m related with frequency ? $3 + 2$
5. What do you mean by magnetostriction ? What is positive and negative magnetostriction ? $3 + 2$
6. What is a load cell ? Which parameter can be measured with it ? Explain the working principle. $1 + 1 + 3$
7. Describe the principle of operation of total radiation pyrometer with diagram.

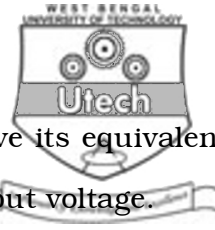


GROUP – C

(Long Answer Type Questions)

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

8. a) Derive the expression for error of a resistive potentiometer when connected across a load of finite resistance. Draw typical curves to show the variation of errors with input displacement for different values of load resistance. 6 + 2
- b) Explain that the sensitivity and linearity are two conflicting requirements in a resistance potential divider. 3
- c) What is meant by gauge factor of a strain gauge ? Derive the expression. Name different strain gauge materials. 2 + 2
9. a) Draw the diagram of an LVDT and explain its electro-mechanical transfer characteristics. 10
- b) Show an arrangement to extract the amplitude as well as the phase information contained in the *ac* output of an LVDT. 5



10. a) What is piezo-electrical transducer ? Give its equivalent circuit. Derive an expression for the output voltage.

2 + 1 + 5

- b) What are the common materials used for piezo-electric transducer ? 2

- c) A barium titanate piezo-electric pick up has dimensions of $6 \text{ mm} \times 6 \text{ mm} \times 1.5 \text{ mm}$ and a voltage sensitivity of $0.012 \text{ V}_m/\text{N}$. Relative permittivity of the barium titanate is 1400 and modulus of elasticity of the barium titanate is $12 \times 10^{10} \text{ N/m}^2$.

Determine :

- (i) The output voltage
 - (ii) Charge sensitivity
 - (iii) Strain
 - (iv) Charge generate and the capacitance of the pick-up. The force applied to the pick-up is 10 N. 5
11. a) What are the advantages of semiconductor strain gauge over metallic strain gauge ? 5



- b) Describe the working and construction of resistance thermometer. Describe the materials used for RTDs along with their properties . Sketch their typical characteristics. 5
- c) Describe Hall Sensor. 5
12. a) State the principle of which the thermocouple works. Mention the name along with its temperature range and composition of two commonly used thermocouples. 5
- b) Why is cold junction compensation is necessary for thermocouple ? What is the technique of cold junction compensation ? 5
- c) Name two IC type temperature sensor. Explain any of them with circuit diagram. 5
13. Write short notes on any *three* of the following : 3 × 5
- a) Photovoltaic cell
 - b) LDR
 - c) Ultrasonic sensor
 - d) Photomultiplier tube
 - e) Thomson effect
 - f) Proximity sensor.

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