

Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.Tech(EIE)/SEM-4/EI-402/2010  
2010**

**SENSORS & 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) The smallest change in input that a transducer can sense is known as
  - a) sensitivity
  - b) resolution
  - c) precision
  - d) accuracy.
- ii) Gauge factor of a strain gauge indicates its
  - a) accuracy
  - b) sensitivity
  - c) dead zone
  - d) none of these.
- iii) The principle of operation of LVDT is based on variation of
  - a) self inductance
  - b) mutual inductance
  - c) reluctance
  - d) permeance.
- iv) ..... is an active transducer.
  - a) RTD
  - b) Strain gauge
  - c) Thermocouple
  - d) LVDT.



- v) Capacitive transducers are normally used for
  - a) static measurement
  - b) dynamic measurement
  - c) both static and dynamic measurements
  - d) transient measurement.
- vi) Hall effect transducers are used for measuring
  - a) magnetic field
  - b) electric field
  - c) current
  - d) both (a) and (c).
- vii) Load cell is a transducer which measures
  - a) force
  - b) temperature
  - c) strain
  - d) pressure.
- viii) Piezoelectric transducers are
  - a) passive transducers
  - b) active transducers
  - c) inverse transducers
  - d) both (b) and (c).
- ix) Which of the following is a digital transducer ?
  - a) Thermistor
  - b) LVDT
  - c) Encoder
  - d) RTD.
- x) In optical pyrometers temperature is measured by the
  - a) thermoelectric effect
  - b) photoelectric effect
  - c) comparison of brightness of the source with that of standard source
  - d) none of these.
- xi) Which of the following temperature sensors has excellent linear characteristics ?
  - a) RTD
  - b) Thermocouple
  - c) Silicon based IC chip
  - d) Radiations pyrometer.
- xii) The photodiode as compared to phototransistor has
  - a) faster switching time
  - b) lower sensitivity
  - c) higher size for the same value of O/P current
  - d) all of these.



**GROUP – B**

**( Short Answer Type Questions )**

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

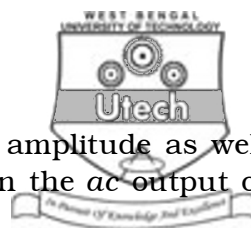
2. Draw the suitable diagram of capacitor microphone and discuss its principle of operation.
3. What are the different types of the inductive transducer ?  
How is displacement measured by such sensor ?  $2 + 3$
4. How can velocity of liquid through a pipeline be measured by using ultrasonic transducer ? Draw necessary diagram.  $3 + 2$
5. Explain with neat diagram the operation of a piezoelectric transducer.
6. a) What do you mean by magnetostriction ?  
b) How can it be used for torque measurement ?  
c) What is positive and negative magnetostriction phenomenon ?  $1 + 2 + 2$

**GROUP – C**

**( Long Answer Type Questions )**

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

7. a) Derive the expression for error of a resistance 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.  
b) Explain that the sensitivity and linearity are two conflicting requirements in a resistance potential divider.  
c) What is meant by gauge factor of a strain gauge ? Derive the expression. Name different strain gauge materials.  $( 5 + 2 ) + 3 + ( 1 + 3 + 1 )$
8. a) Draw the schematic diagram of an LVDT and explain its electro-mechanical transfer characteristics.



- b) Show an arrangement to extract the amplitude as well as the phase information contained in the ac output of an LVDT.
- c) Describe the basic principle of a hall device and show how it can be used as a magnetic field sensor. 5 + 5 + 5
9. a) What is cold junction compensation of thermocouple ? Explain one method of it for continuous temperature measurement.
- b) Calculate the temperature of a furnace if the cold junction temperature is at 34°C and voltmeter gives 41.15 mV for the furnace temperature. Chart of temperature *vs* voltage of a thermocouple when cold junction at 0°C is given.
- |                           |       |       |        |        |
|---------------------------|-------|-------|--------|--------|
| <b>Temperature ( °C )</b> | 30    | 40    | 1030   | 1040   |
| <b>Voltage ( mV )</b>     | 1.203 | 1.611 | 42.432 | 42.817 |
- ( 4 + 5 ) + 6
10. a) Describe the principle of operation of total radiation pyrometer with suitable diagram along with its temperature measuring range.
- b) What is bi-morph ?
- c) Explain photo-electric effect. Show how the phenomenon enables the measurement of electromagnetic radiation.
- d) Distinguish between 'photovoltaic', 'photoconductive', 'photoemissive' cells and suggest the range of wavelength of radiation for which they are suitable.
- 4 + 4 + 3 + 4
11. Write short notes on any *three* of the following : 3 × 5
- RTD
  - LDR
  - Geiger-Müller counter
  - Thermistor
  - Smart sensor.