Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(EEE/ICE)(OLD)/SEM-4/EI-401/2012

2012

TRANSDUCERS AND SENSORS

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) Piezoelectric crystals are used for measurement of ..... changes.

      a) static

      b) dynamic

      c) both static and dynamic

      d) none of these.

   ii) Pt100 signifies

      a) 100 ohm resistance at 0°

      b) 0 ohm resistance at 100°

      c) 100 ohm resistance at all temperatures

      d) none of these.

iii) Thermocouples

a) are most commonly used temperature transducer

b) require reference junction compensation

c) have a low output voltage level

d) all of these.

iv) The residual voltage arises in LVDT due to

a) stray magnetic field

b) electric and magnetic unbalance

c) presence of harmonics in the input signal

d) all of these.

v) Boiler temperature can be measured by which of the following thermal sensors ?

a) Thermistor b) Bimetallic stripe

c) Thermocouple d) Pyrometer.

vi) Push-pull type inductive sensors are used to

a) reduce nonlinearity b) reduce sensitivity

c) increase nonlinearity d) reduce error.

vii) The maximum voltage available from a photovoltaic cell is

a) greater than the equilibrium contact potential of the p-n junction

b) less than or equal to the equilibrium contact potential of the p-n junction

c) both (a) and (b)

d) none of these.

viii) Which of the following photoradiation transducer is an active transducer ?

a) Photoemissive cell b) Photodiode

c) Phototransistor d) Photovoltaic cell.

ix) Dummy strain gauges are employed for

a) calibration of strain gauge

b) increasing the sensitivity of the bridge

c) compensation of temperature variation

d) all of these.

x) Piezoelectric transducers are

a) active transducer

b) passive transducer

c) both active and inverse transducers

d) both passive and inverse transducers.

xi) A Thermistor exhibits

a) only a negative change of resistance with increase in temperature

b) only a positive change of resistance with increase in temperature

c) can exhibits either a negative or positive change of resistance with increase of temperature depending upon the material used

d) none of these.

xii) A Hall effect transducer can be used for the measurement of

a) magnetic field b) current

c) displacement d) all of these.

GROUP – B

(Short Answer Type Questions)

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

2. What is the basic principle behind the working of vapour pressure type thermometer ? How force can be measured by magnetostrictive transducer ? 3 + 2

3. Discuss briefly about the PTC and NTC type thermistors with one example of each. 5

4. Explain Hall effect and Hall coefficient. Describe its application for measurement of displacement. 2 + 3

5. What is residual voltage of LVDT ? The output of an LVDT is connected to a 5 V voltmeter through an amplifier whose amplification factor is 250. An output of 2 mV appears across the terminals of LVDT when the core moves through a distance of 0·5 mm. Calculate the sensitivity of the LVDT and that of the whole setup. The millivoltmeter scale has 100 divisions. The scale can be read to 1/5 of a division. Calculate the resolution of the instrument in mm. 2 + 3

6. Explain the operating principle of photodiode. What is LDR. Explain its operation. 3 + 2

GROUP – C

(Long Answer Type Questions)

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

7. a) A strain gauge having resistance of 350 ohms is subjected to 500 microstrain. Find the change in the value of resistance neglecting the piezoresistive effect.

   b) What are the advantages of semiconductor strain gauge over metallic strain gauge ?

c) Derive an expression of sensitivity of full bridge type strain measurement system.

d) What is rosette ? 5 + 2 + 6 + 2

8. a) Draw the equivalent circuit of the piezoelectric transducer and derive the expression for the transfer function. Hence draw the frequency response curve.

b) Define "d", "g" and "h" coefficient by which the sensitivity of a crystal is identified and obtain the inter relationship between "g" and "h" coefficient.

c) Describe how liquid level can be measured using ultrasonic device. (2 + 3 + 1) + (3 + 3) + 3

9. Explain the construction & principle of working of LVDT. Explain how the magnitude & direction of the displacement of core of an LVDT detected. Why is the frequency of excitation of primary winding kept very high as compared to the frequency of the signal being detected ?

10. a) How capacitive transducer can be used to measure the level of non-conducting liquid ? What special arrangement should be done while measuring the level of the conducting liquid ?

b) Draw and explain the operation of the capacitive type microphone.

c) State the principle of working of the Thermocouple. Describe a suitable hardware method for cold junction compensation of the thermocouple.

(4 + 2) + 4 + (1 + 4)

11. a) Derive the expression for the error of a resistance potentiometer when connected to a load of finite resistance. Draw typical curves to show the variation of errors with input displacement for different value of load resistances.

b) Explain that the sensitivity and linearity are two conflicting requirements in a resistance potential divider.

c) What are "positive magnetostriction" and "negative magnetostriction" ? State Villari effect and Weidman effect. (5 + 2) + 3 + (3 + 2)