Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (EE-NEW)/SEM-8/EE-802B/2011

2011

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) Which of the following gives gauge factor of a strain gauge ?

   a) $(\Delta L/L)/(\Delta R/R)$ b) $(\Delta R/R)/(\Delta L/L)$

   c) $(\Delta R/R)/(\Delta D/D)$ d) $(\Delta R/R)/(\Delta \rho/\rho)$.

   ii) LVDT can be used for

   a) vibration measurement

   b) angular velocity measurement

   c) force measurement in a beam

   d) load measurement on a column.

iii) Hall effect transducers are used for measuring

a) magnetic field b) current

c) electric field d) pressure.

iv) The strain gauges should have low

a) gauge factor

b) resistance temperature coefficient

c) resistance

d) all of these.

v) The sensitivity factor of strain gauge is normally of the order

a) 1 to 1·5 b) 1·5 to 2·0

c) 0·5 to 1 d) 5 to 10.

vi) Which one of the following is digital transducer ?

a) Thermistor b) Encoder

c) LVDT d) RTD.

vii) Which of the following is an inverse transducer ?

a) LVDT b) Load cell

c) Piezoelectric crystal d) Radiation pyrometer.

viii) In optical pyrometers temperature is measured by

a) The thermocouple effect

b) Photocell principle

c) Comparison of brightness of the source with that of standard source

d) None of these.

ix) Venturimeter transducer works on the principle of

a) Pressure difference between two points of flowing fluid

b) Temperature difference in two points in fluid

c) Resistance change in fluid flow

d) Electrical potential gradient between two points in flow line.

x) A quartz resonator is effective in measuring

a) Speed b) Flow of fluid

c) Force d) Temperature.

xi) Residue voltage occurs due to

a) Harmonics and stray capacitance

b) Hysteresis loss

c) Creeping error

d) Eddy current loss.

xii) The 'pH' value of a solution is defined as the

a) Negative logarithm of the hydrogen ion concentration

b) Negative logarithm of the hydroxyl ion concentration

c) Logarithm of the product of hydrogen and hydroxyl ion concentrations

d) Logarithm of the hydrogen ion concentration.

GROUP – B
(Short Answer Type Questions)

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

2. Explain how a Geiger-Muller counter is used for measurement of radioactive radiation. 5

3. Draw the diagram of capacitive microphone. Explain its working principle. 2 + 3

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

5. Describe the function of piezoelectric transducer. 5

6. a) Derive the expression for the loading error of a resistance type potentiometer.

b) Draw typical curves to show the variation of output with input displacement for different values of load resistance. 3 + 2

GROUP – C

(Long Answer Type Questions)

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

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

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

   c) Describe how the error due to temperature is compensated in a strain gauge by using a dummy strain gauge. 5

8. Draw the schematic diagram of an LVDT and explain its electro-mechanical transfer characteristics. How does frequency response of the LVDT depend on excitation frequency ? Explain.

   Design and explain a pressure gauge using LVDT capable to measure pressure both above and below atmospheric pressure (P_0). Also draw the necessary signal conditioning ckt. to indicate +ve for pressure above P_0 and – ve for pressure below P_0. 3 + 3 + 3 + 3 + 3

9. a) State the working principle of Thermocouple. Mention name along with their temperature range and composition of two commonly used thermocouples.

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

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

10. a) Describe the basic principle of a Hall device.

    b) Show how it can be used for magnetic field sensor.

    c) On what factors and parameters of the sensors, does the Hall voltage output depend for a given field condition ?

    d) How is Hall effect transducer utilized for measurement of displacement ? 4 + 4 + 3 + 4

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

a) Proximity sensor

b) Photovoltaic cell

c) LDR

d) Ultrasonic sensor

e) Smart sensor

f) Sensors and transducers.