Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH (ICE)/SEM-5/IC-501/2011-12

2011

INDUSTRIAL INSTRUMENTATION – I

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) Bimetallic strips made of two different materials bend during a rise in temperature on account of

a) differences in coefficient of linear expansion

b) differences in elastic properties

c) differences in the thermal conductivities

d) none of these.

ii) An LVDT has an output in the form of

a) linear displacement of core

b) pulse

c) rotary movement of core

d) angular movement of core.

iii) If the Seebeck coefficient of a *K*-type thermocouple is 40 μV/°C, how much e.m.f. can be expected from it when the hot junction is at 212°F and the cold at 32°F ?

a) 8·48 mV b) 7·2 mV

c) 4 mV d) 2·72 mV.

iv) A Pirani gauge is based on the principle of

a) change in thermal conductivity of a gas with pressure

b) change in the viscosity of a gas with pressure

c) change in the electrical conductivity of a gas with pressure

d) change in the ion current produced by the impact of electrons, with pressure.

v) The full range from atmospheric pressure to a perfect vacuum is

a) 14·7 psi b) 0·40 torr

c) 7·14 psi d) 0·001 – 0·40 torr.

vi) The resistance of Pt-100 RTD at a temperature of 200°C is

a) 138·5 ohms b) 200 ohms

c) 277 ohms d) 177 ohms.

vii) The material commonly used for *C*-type Bourdon tube is

a) copper b) iron

c) steel d) phosphor bronze.

viii) Optical pyrometer is used to measure

a) light intensity

b) low temperature

c) high temperature

d) light intensity and high temperature.

ix) Standard current signal in process industry is

a) 4 – 20 mA b) 0 – 20 mA

c) 10 – 20 mA d) 5 – 20 mA.

x) Smart transmitter allows

a) one-way communication

b) two-way communication

c) both (a) and (b)

d) none of these.

xi) Lower pressure can be measured by

a) diaphragm b) bellows

c) Bourdon tube d) strain gauge.

xii) Radiation densitometers are suitable for

a) liquids and gases

b) solids and liquids

c) solids and gases

d) solids only.

GROUP – B

(Short Answer Type Questions)

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

2. a) What are the different types of manometers ?

b) What type of errors arises in manometers ?

c) Which type of manometer is used for better sensitivity ? Describe it. 1 + 2 + 2

3. a) How do you differentiate between thermoelectric and electrothermic effects ?

   b) Name four types of thermocouples with their respective compositions and temperature range.

   c) What is the function of thermowells in thermocouple ?

   2 + 2 + 1

4. What is hydrometer ? What are the advantages and disadvantages of using hydrometers ? 2 + 3

5. a) What is gauge pressure ?

   b) How is dead weight tester used for pressure instrument calibration ? 1 + 4

6. a) Why is a 2-wire transmitter preferred to a 4-wire transmitter ?

   b) What is the advantage of 4-20 mA signals over a 0-20 mA signal as a standard for transmission ?

   c) If 4-20 mA is the standard for transmission of signal in electrical form, what is the standard for the same in pneumatic form ? 2 + 2 + 1

GROUP – C

(Long Answer Type Questions)

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

7. a) What do you mean by viscosity ?

   b) How is viscosity measured by Saybolt viscometer ?

   c) What are the different types of non-Newtonian fluids ?

   d) What are Saybolt, Redwood & Engler numbers ?

   e) Describe the working principle of Gowmac densitometer. 1 + 5 + 2 + 2 + 5

8. a) How is the low pressure measured by McLeod gauge ? What are measurement ranges ?

   b) What are the limitations of McLeod gauge ?

   c) Show that the scale of McLeod gauge is non-linear. Discuss the method of linearization.

   d) Explain the method of working of Pirani gauge.

   2 + 1 + 2 + 6 + 4

9. a) What is resistance of Pt-100 type RTD at 0°C ? Draw its characteristics. Write down the resistance-temperature relationship.

   b) What factors govern the choice of material for an RTD ? What is self-heating error and how is it corrected in resistance thermometry ?

   c) Draw the schematic diagram for connection of 3-wire or 4-wire RTD. Explain the advantage of 3-wire or 4-wire RTD over a 2-wire RTD. 1 + 1 + 2 + 2 + 2 + 1 + 3 + 3

10. a) Distinguish between absolute pressure, vacuum pressure and differential pressure.

    b) Explain the working principle of *C*-type Bourdon gauge. Why is cross-section of Bourdon elliptical ?

    c) Find out the error in reading in a Bourdon gauge if it is mounted 5 metre below and 5 metre above the process water flow pipeline. Note that water pressure in the pipeline is to be measured. 4 + 5 + 2 + 4

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

    a) Cold-junction compensation

    b) I/P and P/I converter

    c) Semiconductor temperature sensors

    d) Fluidic sensor

    e) Resistive type electrical pressure measurement.