

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 $40 \mu\text{V}/^\circ\text{C}$, 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.



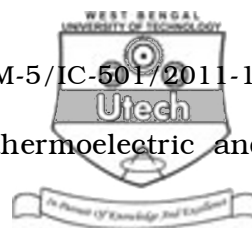
- x) Smart transmitter allows
- a) one-way communication
 - b) two-way communication
 - c) both (a) and (b)
 - d) none of these.
- xi) Lower pressure can be measured by
- a) diaphragm
 - b) bellows
 - c) Bourdon tube
 - d) strain gauge.
- xii) Radiation densitometers are suitable for
- a) liquids and gases
 - b) solids and liquids
 - c) solids and gases
 - d) solids only.

GROUP – B

(Short Answer Type Questions)

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

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



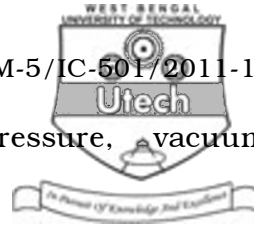
GROUP – C

(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.
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