INSTRUMENTATION AND TELEMETRY
(AEIE 4181)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

    (i) Chemical seal is used
    (a) to protect the measuring device from corrosive effect of the process fluid
    (b) to measure the flow rate
    (c) to measure the pressure
    (d) none of these.

    (ii) Capsule is made of
    (a) two diaphragms of equal size (b) two bellows of equal size
    (c) two chemical seals of equal size (d) none of these.

    (iii) Internationally accepted pressure transmitter output in psi unit is equal to
    (a) 3 -15 psi (b) 10 -100 psi
    (c) 1 -1.2 psi (d) none of these.

    (iv) K-type thermocouple is made by
    (a) chromel-constantan (b) iron-constantan
    (c) chromel-alumel (d) copper-constantan.

    (v) Dead weight tester is used for
    (a) testing dead weight
    (b) producing high pressure
    (c) measuring process pressure accurately
    (d) calibrating pressure instruments.

    (vi) Internationally accepted current transmitter output is equal to
    (a) 0 - 20 mA (b) 4 - 20 mA
    (c) 10 - 50 mA (d) 3 - 15 mA.

    (vii) In case of source coding using BCD, C2 is coded as
    (a) 0111 0010 (b) 1100 0010
    (c) 1010 0010 (d) 0010 1010

    (viii) Which of the following type is used for non-contact type level measurement?
    (a) Float type (b) Ultrasonic type
    (c) Displacer type (d) Capacitive type.

    (ix) For the construction of RTD the best choice is
    (a) balco (b) copper (c) nickel (d) platinum.

    (x) One Torr is equal to
    (a) one mm Hg (b) one inch Hg
    (c) one atmosphere (d) one kilo Pascal.

Group – B

2. (a) With neat diagrams explain the construction and working of McLeod gauge for non-linear type. Why is a McLeod gauge considered to be a standard for measurement of pressure in the vacuum range?

    (b) The volume of bulb and measuring capillary of a McLeod gauge is equal to 110×10^{-6} m³ and its measuring capillary diameter is 1 mm. Calculate the pressure indicated when reading of measuring capillary is 30 mm in case approximate formula is used. What is the error if the exact formula is used for pressure measurement?

    (6 + 2) + 4 = 12

3. (a) Define Reynold's number. State its significance in determining flow characteristics. Derive the expression for volumetric flow rate through restriction for incompressible fluids.

    (b) The following data relate to an orifice meter: Diameter of the pipe = 300 mm; Diameter of the orifice = 150 mm; Reading of the differential manometer = 500 mm of mercury; Sp. gravity of oil = 0.9; Coefficient of discharge of the meter = 0.64. Determine the rate of flow.

    (1 + 2 + 5) + 4 = 12

Group – C

4. (a) What are the different types of Thermistor? Show how temperature coefficient of resistance is related to temperature for PTC type Thermistor. Find the resistance of Thermistor at 0° C and 100° C if reference temperature is 25° C and β is 4000. It is provided that resistance of Thermistor at reference temperature is 10 K Ω.

(b) State the laws of thermoelectric circuits. Design a hardware compensation circuit for cold junction compensation of thermocouples for industrial temperature measurement.

(2 + 2 + 2) + (2 + 4) = 12

5. (a) How the level of a conducting fluid is measured by capacitive method?

   (b) How a liquid level control scheme can be designed by using displacer type level gauge?

   6 + 6 = 12

Group – D

6. (a) Design a circuit to generate 4-20 mA using Voltage to current (V to I) conversion technique.

   (b) What are the advantages of current transmitter over voltage transmitter? Explain with the help of electrical circuit theorem.

   6 + 6 = 12

7. (a) Design and explain a pulse generator with the help of integrator and Schmitt trigger.

   (b) If the carrier amplitude is 10 V and load is 10 ohms, calculate the sideband power for an amplitude modulation of index 0.5.

   8 + 4 = 12

Group – E

8. (a) What is time division multiplexing? With necessary diagrams briefly explain the transmission and reception of multiple sensor data in TDM-PAM system.

   (b) What is aliasing?

   (2 + 8) + 2 = 12

9. (a) Show how frequency of the output signal is related to the modulating voltage of a voltage controlled oscillator using necessary circuit diagram. How it is used in PLL circuit for FM demodulation.

   (b) What is cross-talk in FDM system?

   (7 + 3) + 2 = 12