M.TECH/AEIE/1ST SEM/AEIE 5103/2016

ADVANCED INDUSTRIAL INSTRUMENTATION
(AEIE 5103)

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

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> 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) The desirable property of a manometric fluid is
   (a) high viscosity
   (b) high coefficient of thermal expansion
   (c) low vapour pressure
   (d) corrosiveness and stickiness.

   (ii) The Primary standard for calibrating vacuum is
   (a) Mc Leod gauge   (b) Dead weight tester
   (c) Thermocouple gauge   (d) Kundsen gauge.

   (iii) A pressure gauge is used to measure vacuum indicates a gauge pressure of 5 kPa. If the atmospheric pressure is 100 kPa, the absolute pressure is
   (a) 95 kPa   (b) 0.05 kPa
   (c) 105 kPa   (d) 20 kPa.

   (iv) The meter which is suitable for flow totalization is
   (a) Turbine meter   (b) Venturi meter
   (c) Ultrasonic flow meters   (d) Orifice meter.

   (v) Zirconium probe is commonly used to analyse _____ content of flue gas.
   (a) CO_2 (b) O_2 (c) NO_x (d) SO_x.

   (vi) The thermocouples are
   (a) output transducers   (b) active transducers
   (c) passive transducers   (d) both active and passive transducers.

   (vii) A Pt_{100} RTD has resistance
   (a) 0 Ω at 0°C   (b) 0 Ω at 100°C
   (c) 100 Ω at 0°C   (d) 100 Ω at 100°C.

   (viii) To neglect the effect of density change, the float density (ρ_f) of the rotameter should be _____ density of the liquid (ρ_l) under consideration
   (a) equal to   (b) greater than $2\rho_l$
   (c) less than $2\rho_l$ (d) none of these.

   (ix) Discharge coefficient is minimum for
   (a) Turbine meter   (b) Venturi meter
   (c) Ultrasonic flow meters   (d) Orifice meter.

   (x) The cold junction compensation of thermocouples primarily based on
   (a) Laws of intermediate metal
   (b) Laws of homogeneous metal
   (c) Laws of intermediate temperature
   (d) None of these.

Group – B

2. (a) Describe with necessary circuit diagram, how the error due to lead resistance can be reduced in 3-wire RTD over the 2-wire RTD.

   (b) Describe the operation of the McLeod Gauge, both non-linear and linear types.
   6 + 6 = 12

3. (a) Derive the expression for volume flow rate from Bernoulli's equation.

   (b) Describe the principle of operation of the variable area flow meter and hence find the expression for the volume flow rate of the same. By rotameter, is it possible to measure the flow rate of a liquid having density higher than that of the float?
   5 + 5 + 2 = 12

Group – C

4. (a) Describe the method of level measurement in boiler drum with necessary schematic diagram.

(b) Hence draw the computational block diagram for the pressure compensated drum level.

6 + 6 = 12

5. Explain single, two and three element boiler drum level control with necessary PI diagram.

3 + 4 + 5 = 12

Group – D

6. (a) Describe the operation and control of a heat exchanger unit in a chemical plant.

(b) Draw the schematic for the distillation column.

8 + 4 = 12

7. (a) Describe the method of liquid-gas interface level measurement system in chemical plant.

(b) State different types of maintenance activity of the instruments.

6 + 6 = 12

Group – E

8. Write short notes on any two from the following: **6 × 2 = 12**
   (i) Flame Scanner
   (ii) Smoke detector
   (iii)Hazardous area classification recommended by the International Electrotechnical Commission (IEC).

9. Describe the working of the Zener barrier devices in intrinsically safe electronic systems with necessary circuit diagram. Hence derive the expression for the maximum total stored energy in the circuit.

8 + 4 = 12