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
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) A flow meter that measures flow which are independent of density is
(a) Rotameter   (b) Electromagnetic flowmeter
(c) Venturi meter   (d) Orifice meter.

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

(iii) Reynolds number for flow through a pipe is given by
(a) $vd\mu/\rho$ (b) $vd\rho/\mu$
(c) $v\rho\mu/d$ (d) $\rho d\mu/v$.

(iv) A Bourdon tube is used to measure pressure indicates 5 kPa. If the atmospheric pressure is 100 kPa, the absolute pressure is
(a) 105 kPa   (b) 0.05 kPa
(c) 95 kPa   (d) 1.05 kPa.

(v) The temperature of the furnace is measured by
(a) RTD   (b) Liquid filled thermometer
(c) Thermistor   (d) Thermocouple.

(vi) Mc Leod gauge is used to measure
(a) Absolute pressure   (b) Gauge pressure
(c) Differential pressure   (d) pH.

(vii) Use of thermo-well
(a) decreases the time of response   (b) increases the time of response
(c) does not alter time of response   (d) none of these.

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

(ix) Released electrical or thermal energy from an intrinsically safe instrument under normal or abnormal condition should be _____ the ignition energy of a specific flammable or combustible atmospheric mixture.
(a) above   (b) below
(c) equal to   (d) none of these.

(x) A Pt100 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.

Group - B

2. (a) Define the laws of thermocouple? Design necessary signal conditioning circuit for a thermocouple.

(b) Describe the operation of ultrasonic level measurement system with necessary expression for the level.

(4 +3) + 5 = 12

3. (a) Design a pressure measuring system using LVDT as a secondary transducer. Hence derive the expression for the sensitivity of the system.

(b) Design signal conditioning circuit for 3-wire RTD and derive the output expression for the same.

(5 + 2) + 5 = 12

Group - C

4. (a) With necessary schematic diagram, explain the method of boiler drum level measurement. Hence find the expression for the pressure compensated drum level.

(b) State the importance of the conductivity measurement in boiler feedwater.

(4 + 4) + 4 = 12

5. (a) Describe the operation of infrared spectrometer used for concentration measurement of SO_x.

   (b) State the operation of a smoke detector.

   6 + 6 = 12

Group - D

6. (a) Draw the schematic diagram of a distillation column and indicate different temperature measurement points. Why pressure control of the distillation column is necessary?

   (b) Explain the method of liquid-liquid interface level measurement system in chemical plant.

   (4 + 4) + 4 = 12

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

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

   6 + 6 = 12

Group - E

8. (a) Draw the circuit diagram of the Zener barrier devices in intrinsically safe electronic system. Hence derive the expression for the maximum total stored energy in the circuit.

   (b) Describe the operation of Fire Detector.

   8 + 4 = 12

9. Write short notes **(any two)**:
   (i) Fire detector.
   (ii) Smoke detector.
   (iii) Hazardous area classification recommended by the International Electro technical Commission (IEC).
   (iv) Hydrocarbon (HC) detector.

   2 × 6= 12