**INDUSTRIAL INSTRUMENTATION**

**(AEIE 3103)**

**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) An orifice plate suitable for measurement of flow rate of clean fluids is a
    (a) Concentric orifice       (b) Conical edge orifice
    (c) Segmental orifice       (d) Eccentric Orifice.

  (ii) To make the Rotameter indication to be independent of fluid density:
    (a) Float density must be twice of the fluid density
    (b) Float density must be equal to the fluid density
    (c) Float density must be half of the fluid density
    (d) Float density must be thrice of the fluid density.

  (iii) An electronic level transmitter with a 4 - 20 mA output is calibrated to range of 10 cm to 100 cm. If the transmitter output is 12 mA then the liquid level is
    (a) 55 cm     (b)67.5 cm     (c) 75cm     (d) 45cm.

  (iv) Working principle of radiation pyrometer is based on the
    (a) Wien's law       (b) Kirchoffs law
    (c) Stafan-Boltzman law       (d) Seeback effect.

  (v) Which of the following thermocouples is the most suitable for measuring a temperature of about 1600°C in an oxidizing atmosphere?
    (a) Platinum - Platinum + Rhodium     (b) Iron-Constantan
    (c) Chromel - Alumel     (d) Copper-Constantan.

  (vi) Which of the following is not a flow measurement element?
    (a) Venturi     (b) Rotameter     (c) Burdon     (d) Flow nozzle.

  (vii) The Reynolds number for flow in a pipe is given by
    (a) $\dfrac{vd\mu}{\rho}$     (b) $\dfrac{vd}{\rho\mu}$     (c) $\dfrac{vd\rho}{\mu}$     (d) $\dfrac{vd\mu}{\rho}$ .

  (viii) K - type T/C is made of
    (a) Cu, Constantan       (b) Chromel, Constantan
    (c) Pt, Pt Rhodium       (d) Chromel, Alumel.

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

  (x) In ultrasonic level gauge, the ultrasonic source is placed at the
    (a) bottom of the vessel containing the liquid
    (b) top of the vessel containing the liquid
    (c) middle of the vessel containing the liquid
    (d) far from the vessel containing the liquid.

**Group – B**

2. (a) Why mercury is mostly used as manometric fluid?

  (b) Explain the working principle of well type manometer.

  (c) Describe how ionization gauge is used for measurement of very low pressure.

       **3 + 3 + 6 = 12**

3. (a) Briefly explain with proper diagram, the operating principle of pneumatic force-balance system with flapper & nozzle.

  (b) Describe with a proper diagram how absolute pressure can be measured using bellows element.

       **6 + 6 = 12**

**Group – C**

4. (a) What are the different types of ultrasonic flowmeter? Show that ultrasonic flow measurement system by measuring frequency shift is independent of sonic velocity.

  (b) If the K-factor of a vortex flow meter is 7200 per cubic meter. Then what shall be the vortex shedding frequency for a flow rate of
    i) 1 $m^3$/sec    &    ii) 100 $m^3$/hr

  (c) What is the reason behind the permanent pressure drop across an orifice meter?

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

5. (a) Describe the working principle of turbine type flow meter. How the speed of rotation of turbine flow meter is monitored?

 (b) What is Doppler effect?

 (c) What is an 'Annubar tube'?

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

## Group – D

6. (a) Explain with a neat diagram, the method of level measurement in an open– to – atmosphere tank using differential transmitter.

 (b) A pressure gauge located at the base of an open tank containing liquid of specific weight of 54.5 lb/ft$^3$ registers 1684.8 pound-force/ ft$^2$. What is the depth of the fluid in the tank?

 (c) A displacer with a diameter of 8 inch is used to measure changes in water level. If the water level changes by 1 ft what is the change in force sensed by the force sensor? (Specific weight of water is 62.43 lb/ft$^3$.)

$$5 + 3 + 4 = 12$$

7. (a) How the level of fine particles is measured by capacitive type system?

 (b) What are the differences between memory mapped I/O and I/O mapped I/O schemes?

 (c) Calculate the buoyancy force on an object that displaces 3 m$^3$ of water at 20$^0$C. (Assume density of water as 1g/cm$^3$.)

$$5 + 5 + 2 = 12$$

## Group – E

8. (a) State & explain the different laws associated with the operation of thermocouple.

 (b) What is a thermowell and where is it used?

 (c) Describe the self heating error of RTD.

$$6 + 2 + 4 = 12$$

9. (a) Describe the operation of liquid in glass thermometer with schematic diagram.

 (b) What is a thermostat?

 (c) Write a short note on thermistors.

$$4 + 3 + 5 = 12$$