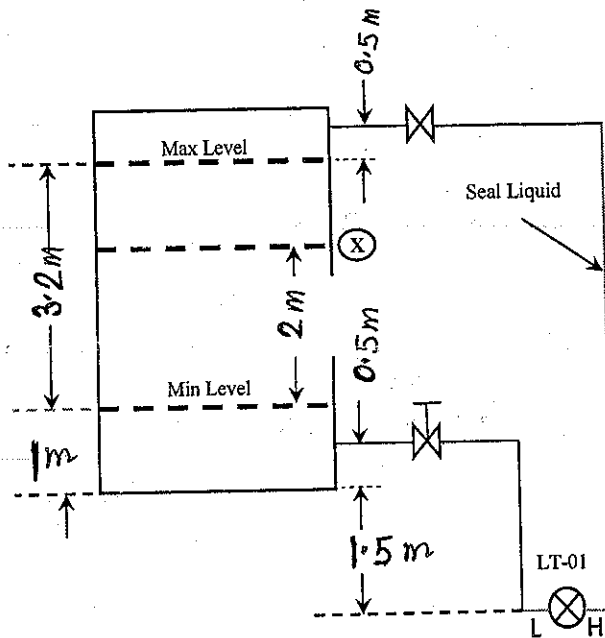


Instruction : Answer one question each from Sections I - IV

Section I

1a) What do you understand by Wet Leg compensation ? Draw a labelled schematic diagram to explain your answer. Derive an expression for the range of differential pressure for direct transmitter output. Comment on the zero adjustment required. 12

b) In the level measurement scheme below, LT 01 is a differential pressure type level transmitter calibrated to give 4-20 mA over the full range. 8



(i) Express the range of the transmitter in mmwc

(ii) sketch the level vs output curve

(iii) what shall be the output in mA from LT 01 when the level is at X

(iv) What will happen if the H and L connections are switched ?

[Given : density of process liquid = 0.9 gm/cc  
Density of seal liquid = 1.25 gm/cc]

2a) In a Hydrostatic Tank Gauging system, explain how the mass and level of liquid in a cylindrical tank are determined. Draw a diagram in support of your answer. Also, distinguish between actual and standard volume, and explain how they are determined. What are the common alarms associated with such a system ? 10

b) A PVC coated capacitive probe is used to measure the level of a non-conducting liquid in a cylindrical metallic tank. Draw a sketch of the installation as also its equivalent circuit. Explain its working and show that the level in the tank is proportional to the probe capacitance. 10

Section II

3a) What do you understand by a SAMA Class VA filled-in-system. Explain the type of compensation provided for this system. Why is such compensation required ? Elaborate on how such compensation can be implemented. 12

b) What is meant by self-heating error in the context of resistive temperature sensors. Name the units in which this error is expressed. 4

c) The resistance of a Nickel RTD at 100 and 200 deg C are 1600 and 2200 ohm respectively. Sketch its characteristic (assuming it to be linear) curve. What shall be its resistance at 100 degC ? 4

4a) Why is Cold Junction Compensation required for a temperature measurement system using a Thermocouple ? Show that with compensating cables being used (instead of copper cables), CJC is needed only for the junction at the control room end. 12

b) What are the advantages of mineral insulation in MI thermocouples ? 4

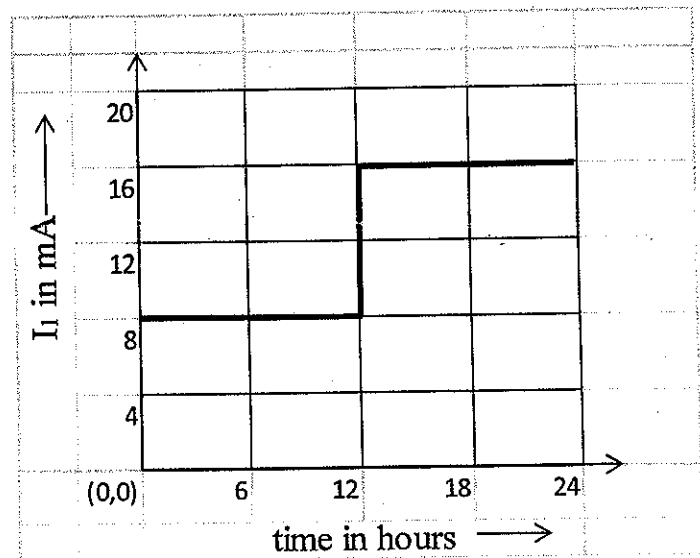
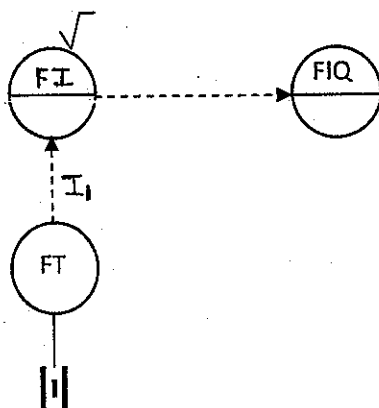
c) A K-type thermocouple produces a voltage which is measured by the potentiometer as 25mV. Determine the temperature T when the Reference Junction isothermal block is indicated by a thermistor as 0 degC. Seebeck coefficient is 40  $\mu\text{V}/\text{deg C}$ . 4

### Section III

5a) With the help of necessary diagrams describe the construction and explain the operation of an Electromagnetic Flowmeter. What are the advantages of pulsed DC excitation over AC excitation ? Comment on the straight run requirements of this flowmeter. 14

b) An orifice + DP Tx arrangement alongwith a flow totaliser(FIQ) is being used to keep track of the total flow occurring every day. The range of the FT is 0 - 100 m<sup>3</sup>/hr. Refer the figures below and find the totalised value of the flow after 24 hours. What is the instantaneous flow rate after 9 hours ? 6

FI : Flow Indicator  
FIQ : Flow Totaliser



6a) Establish the relation between the distance travelled by the float and the volumetric flow rate for a Variable Area Flowmeter. A neat labelled explanatory diagram is a must. Which area is made "variable" and how? How can measurement be made immune to density variations of the process fluid? 10

b) With the help of a sketch explain the working of a Transit Time Ultrasonic flowmeter. What is the main source of error in this instrument and how is it removed? Why is a "chordal path" chosen to transmit the beam across the pipe section? 10

#### Section IV

7) What is meant by an explosion proof level switch? Explain the concept of intrinsic safety. Refer the diagram below and classify the areas A, B, C and D as per IEC Zones. Explain the basis of this classification. 20

8) Discuss the features of a smart transmitter and explain its advantages over an analog one. What is the HART protocol and how is it used in such a transmitter? Draw a schematic diagram for multidrop configuration for such transmitters. 20

#### Section V

9) Write short notes on 5 x 4 = 20

a) FMCW Radar level instrument or Displacer type level switch

b) Thermistors or Lead wire compensation in RTD

c) PD Meter or Thermal Mass Flowmeter

d) Weatherproof Certification of Instruments