Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. Sem-Vth Examination December 2010

Subject code: 151402

Subject Name: Food Process Instrumentation and Control

Date: 16 /12 /2010 **Time: 03.00 pm - 05.30 pm**

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** A rotameter uses a cylindrical float 0.02 m height and 0.02 m in diameter, which is tapered at 5^0 from the bottom inlet. The float reaches to a height of 0.025 m with a given flow rate. If the discharge coefficient is 0.5 and the maximum and minimum diameter of the tube is 0.04 m and 0.03 m respectively. Assume no significance of velocity approach factor. Calculate maximum flow rate if float density is 4 times the fluid density and area of float is 0.00010255 m^2. **07**

(b) Describe about Total Immersion (TI) and Partial Immersion (PI) thermometer in detail and explain the error calculation and then apply correction factor in TI when "TI is partially immersed" (assume data). **07**

Q.2 **(a)** Explain the working principle of metallic resistance thermometer (RTD) with diagram. A thermistor has a resistance of 9000 Ω at the ice point and 500 Ω at 100^0C. Find its constant β and its resistance at 50^0C. **07**

(b) Explain in details the different laws of thermocouple. List out the factors for selection of thermocouple. Write down the material of construction and temperature range for J, K, E and S type thermocouples. **07**

OR

(b) Describe the followings **07**

1. Capacitance type level gauge
2. Pressure thermometers, Constant volume thermometer

Q.3 **(a)** Explain the commercial scales used for measuring specific gravity. Describe the Bubbler method and LVDT type hydrometer in details. **07**

(b) A bimetal strip 55 mm long is made of strips of nickel-chrome alloy and bonded together at 30^0C. Each material has a thickness of 1.5 mm. Find the radius of curvature of the strip subjected to 110^0C. Take the following data for material properties. $\alpha_A = 12.5 \times 10^{-6}\ ^0C^{-1}$, $\alpha_B = 1.5 \times 10^{-6}\ ^0C^{-1}$, $E_A = 2.3 \times 10^{11} N/m^2$, $E_B = 1.5 \times 10^{11} N/m^2$ **07**

OR

Q.3 **(a)** Define different types of flow. List out different types of flow meters. Explain the working principle of rotameter with diagram. **07**

(b) Give the detail design of orifice plate and develop the following equation **07**

$$Q_v = E\,A_2\sqrt{2g\left(\frac{P_1 - P_2}{\rho}\right)}$$

Q.4 **(a)** Show with the help of diagram different elastic elements to measure the pressure. Explain working of Bourdon gauge and LVDT type pressure transducer. **07**

(b) Show possible arrangements of strain gauges for measurement of force P. Also Develop the equation **07**

$$I_G = \frac{-E\Delta R_1}{4R_1(R_1 + R_G)}$$

OR

Q.4 **(a)** Explain the followings **07**

1. Bubbler liquid level meter
2. Capaciatnce type level gauge
3. Rotameter type viscometer
4. None self generating transducer

(b) What are the different types of errors in experimental data? Explain any two errors in detail. **07**

Q.5 **(a)** Explain the principle of target and magnetic flow meter. Derive an expression V= E/K. **07**

(b) Write the purpose of following equipments in one line **07**

1. Saccharometer
2. Turbine meter
3. Lactometer
4. Hydrometer
5. Bourdon gauge
6. Aerometer
7. Pycnometer

OR

Q.5 **(a)** List out the reasons why mercury is preferred to be use in thermometer. Why platinum is most widely used material for resistance element. **07**

(b) How the semiconductors and conductors are different with its characteristics to each other. Describe the working of metallic resistance thermometer. **07**

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