

GUJARAT TECHNOLOGICAL UNIVERSITY**BE – SEMESTER V • EXAMINATION – WINTER - 2012****Subject code: 151402****Date: 17-01-2013****Subject Name: Food Process Instrumentation and Control****Time: 02:30 pm to 05:00 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)** Fill in the blanks with appropriate choice: **07**
1. The boiling and freezing point of water at a pressure of one atmosphere are _____ and _____.
 2. The coefficient of expansion for mercury in degree Celsius is _____.
 3. E-type thermocouple is made up of _____.
 4. Devices that measure temperature on the basis of thermoelectric principle are called _____.
 5. In laminar flow, average velocity is _____ maximum.
 6. Rotameter is always installed in _____ position.
Hair hygrometer is used to measure _____.
- (b)** Specify different limitations and advantages of thermocouples. Discuss the laws of thermocouple in detail. **07**
- Q.2 (a)** Being a poor conductor of heat why is mercury used in thermometers. Differentiate between Total Immersion and Partial Immersion thermometer. With example show the calculation of error and apply correction in Total Immersion thermometer. **07**
- (b)** Describe the followings in detail: **07**
1. Semiconductor resistance sensor and its advantages.
 2. Pressure thermometer

OR

- (b)** A rotameter is calibrated for metering a liquid of density 1000kg/m^3 and has a scale ranging from 1 to 100 l/m. It is intended to use this meter for metering the flow of gas of density 1.25kg/m^3 with a flow range between 20 to 2000 l/m. Determine the density of the new float, if the original one has a density of 2000kg/m^3 . The shape and volume of both the float is assumed to be the same.
- Q.3 (a)** Describe the detail design of orifice plate and also define vena contracta. Discuss different types of orifice plates. **07**
- (b)** Describe detailed design of target flow meter with diagram. Also prove that **07**

$$V = \sqrt{\frac{2 \varepsilon E I}{(L - x) y C_d \rho A}}$$

OR

- Q.3 (a)** Describe detailed design of magnetic flow meter with diagram. Also prove that voltage developed is proportional to velocity. **07**
- (b)** Explain the following in brief: **07**

1. Factors for selection of thermocouples
2. Negative Temperature Characteristics
3. Gauge factor
4. Bellows and Corrugated diaphragm
5. Lactometer and Alcoholometer
6. Pitot tube
7. Baume scale

Q.4 (a) List out different instruments used for the measurement of Specific gravity, Liquid level, Viscosity measurement. Explain the working of capillary tube viscometer (constant head type). **07**

(b) Differentiate between the following: **07**

1. Sensor and Transducer
2. Active and Passive transducer
3. Thermocouple and Thermistor
4. K-Type and T-type Thermocouple

OR

Q.4 (a) What is RTD and where it is used? Give reasons why for most laboratory and industrial measurements platinum is considered as the most suitable material. **07**

Q.4 (b) What is thermopile? What materials are used for manufacturing of thermocouples? State the applications of thermocouples. **07**

Q.5 (a) A bimetal strip was made of strips of nickel-chrome alloy and invar bonded together at 20°C. Each material had a thickness of 2mm and the composite element was fixed at one end with the other end kept free. The length of the cantilever was 50mm. Determine the radius of curvature of the strip subjected to 100°C. Take the following data of the material properties. **07**

$$\begin{array}{ll} \text{For invar } \alpha = 1.7 \times 10^{-6} \text{ } ^\circ\text{C}^{-1} & E_1 = 1.5 \times 10^5 \text{ N/mm}^2 \\ \text{For nickel-chrome } \alpha = 12.5 \times 10^{-6} \text{ } ^\circ\text{C}^{-1} & E_1 = 2.2 \times 10^5 \text{ N/mm}^2 \end{array}$$

(b) Explain resistance strain gauges. Also discuss different types of strain gauges. Explain resistance strain gauge bridges. **07**

OR

Q.5 (a) A load cell is formed of a hollow steel cylinder loaded axially. The four strain gauges are so connected as to enhance the signal and compensate for temperature variations. The load cell has the cross sectional area of 2cm², young modulus of steel is 2.07 x 10¹¹ N/m² and poissons ratio 0.3. Strain gauge resistance is 1000Ω, gauge factor is 2.1 and the current in each strain is limited to 20ma. Calculate (a) Bridge supply voltage, (b) current in detection arm if this consists of a micrometer of 500Ω resistance, when the load cell is subjected to a force of 10⁵N. **07**

(b) Discuss the principle of positive displacement meter. List out different types of positive displacement meters. Explain the working principle of turbine flow meter with diagram. **07**
