Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–V • EXAMINATION – SUMMER • 2014**

**Subject Code: 151402** **Date: 19-06-2014**

**Subject Name: Food Process Instrumentation and Control**

**Time: 10.30 am - 01.00 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)** Draw the neat and clean diagram only of the followings; **14**

1. Knudsen gauge
2. McLeod gauge
3. Float gauges
4. Orifice plate
5. LVDT type hydrometer
6. Rotameter
7. Turbine flow meter

**Q.2** **(a)** What are different types of scale to measure specific gravity measurement? Discuss the working of target and magnetic flow meters with diagram. **07**

**(b)** Define the following terms **07**

1. Error
2. First order system
3. Laplace transform
4. Load disturbance
5. Controller
6. Tolerance
7. Controlled variable

**OR**

**(b)** Describe in brief about Bode diagram. Derive an expression of Laplace transform for exponential and ramp functions and explain with graphs. **07**

**Q.3** **(a)** Explain with diagram the different arrangements of thermocouple in which emf will not change. List the advantages and limitations of thermocouple. **07**

**(b)** The following data are available for mercury thermometer. Calculate. **07**
(1) How much error do you have for incorrect immersion of thermometer?
(2) What is the actual temperature of the liquid is being measured?

1. Graduated from -3 to $101^0$C with a 0.3 divisions.
2. We are measuring the temperature of a liquid in a beaker.
3. Thermometer is immersed to $33^0$C marks.
4. Then the reading of the thermometer is $92.15^0$C.
5. Assume average temperature of the liquid column is $27^0$C.

**OR**

**Q.3** **(a)** Explain the working of feed forward and feedback control loops with figure. **07**

**(b)** Match the followings **07**

| | |
|---|---|
| Reynold number | Flow |
| Bimetallic strip | Thermocouple |
| Rotameter | Relative humidity |
| See beck | Pressure |
| Bourdon gauge | Specific gravity |
| Hygrometer | Flow pattern |
| Pycnometer | Temperature |

**Q.4** **(a)** Discuss about Laminar, Transient, Turbulent flow and Vena contracta. Derive the expression for the volume flow rate of a one dimensional incompressible fluid flow through a horizontal pipe installed with an orifice meter by Bernoulli's theorem. **07**

**(b)** Discuss Bubbler method and LVDT type hydrometer with diagram. Discuss the principle of target flow meter. **07**

**OR**

**Q.4** **(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 four temperature variations. The load cell has the cross sectional area of $2cm^2$, young modulus of steel is $2.07 \times 10^{11}$ $N/m^2$ 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 $10^5$N. **07**

**Q.4** **(b)** Explain the working of Pirani Gauge and List of approximate range of various pressure measuring devices. Also discuss the Positive flow meters. **07**

**Q.5** **(a)** A gauge, made of a material having a resistance temperature coefficient of $12 \times 10^{-4}$ $/^0C$, has a resistance of 120Ω and a gauge factor of 2. It is connected to a bridge having resistance of 120Ω each. The bridge is balanced at ambient temperature. If the temperature changes by $20^0C$, find; **07**

1. Output voltage of the bridge if the input voltage is 10V
2. The equivalent strain represented by the change in temperature

**(b)** What is transducer? List out different factors for selection of transducers. Discuss bonded and un-bonded strain gauge. **07**

**OR**

**Q.5** **(a)** Differentiate between balance and unbalance bridge with diagram and prove that; $I_G = \frac{(-EF\varepsilon_1)(R_1 + R_G)^{-1}}{4}$ **07**

**(b)** Discuss the followings in brief **07**

1. Advantages and disadvantages of mercury.
2. Constant volume thermometer
3. Vapour pressure thermometer

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