

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2122

Roll No.

--	--	--	--	--	--	--	--	--	--

B. Tech.

(SEM. V) THEORY EXAMINATION, 2012-13

INDUSTRIAL INSTRUMENTATION

Time : 3 Hours]

[Total Marks : 100

SECTION – A

1. Attempt **all** question parts : **10 × 2 = 20**
- A capacitive transducer consists of two plates of diameter 2 cm each, separated by an air gap of 0.25 mm. Find the displacement sensitivity.
 - Specify the main drawbacks of McLead gage.
 - State the intermediate metals law in thermocouple.
 - Mention some applications of bimetallic thermometer.
 - State the principle of ultrasonic flow meter.
 - The variable area is used in rotameter. Give the reason.
 - Write down the formula of Saybolt viscometer.
 - List out the advantages of null balance method.
 - What is the need for the measurement of moisture ?
 - Specify the application of Humistor.

SECTION – B

2. Attempt any **three** question parts : **10 × 3 = 30**
- Enlist the various types of strain gauges and explain any one of them.
 - Give the working principle of LVDT with a neat sketch.

- (b) A 500 resistance thermometer carries 5-mA current. Its surface area is 0.5 in^2 , and it is immersed in stagnant air, so that the heat transfer coefficient is $U = 1.5 \text{ Btu}/(\text{h}\cdot\text{ft}^2\cdot\text{f}^\circ)$. Find its self heating error. What would be error in water with $U = 100 \text{ Btu}/(\text{h}\cdot\text{ft}^2\cdot\text{f}^\circ)$?
- (c) What is manometer ? Enlist the different type of manometer and explain inclined type manometer with proper diagram.
A manometer has a well of 18 mm in diameter and a tube of 3 mm of inner bore. It is proposed to use a scale graduated accurately in mm to measure the pressure directly i.e. 1 mm scale division indicates a 1 mm pressure head change. Calculate the angle at which the tube must be inclined to vertical to do this. Density of mercury is $13.56 \times 10^3 \text{ kg}/\text{m}^3$. Assume $1 \text{ mm of Hg} = 133 \text{ N}/\text{m}^2$.
- (d) What is humidity measurement ? Explain about distillation method. Write its merits and demerits.
- (e) A pitot tube is used to measure flow velocity in water of density $1000 \text{ kg}/\text{m}^3$.
(i) Determine the flow velocity at the head of pitot tube if it produces differential pressure of $10 \text{ kN}/\text{m}^2$ between its two outlets.
(ii) The same differential pressure is obtained in air at altitude where the density of air is $0.65 \text{ kg}/\text{m}^3$. Determine the velocity of air.

SECTION - C

Attempt all question :

$10 \times 5 = 50$

3. Attempt any two parts :

$(5 \times 2 = 10)$

- (a) A U-tube manometer is used to measure a differential air pressure with a fluid of density $400 \text{ Kg}/\text{m}$. The air is at 280 kPa and $27 \text{ }^\circ\text{C}$. Calculate the differential pressure if the difference in the height of the fluid in the manometer is 110 mm . Express in units of kPa .
- (b) Illustrate about the construction of resistance thermometer (pirani) gage where the functions of heating and temperature measurement are combined in a single element.
- (c) A piezo-electric transducer has the following characteristics :
Capacitance of crystal = 10^{-9} F
Capacitance of cable = $3 \times 10^{-10} \text{ F}$
Charge constant of crystal = $4 \times 10^{-6} \text{ C}/\text{cm}$

The oscilloscope used for read-out has a resistance of 1M in parallel with a capacitance of 10^{-10} F . Find the amplitude of the output voltage, as displayed on the oscilloscope, if the crystal is subjected to a harmonic deformation of amplitude 10^{-3} mm and frequency 200 Hz .

4. Attempt any one part : (1 × 10 = 10)

- (a) A power radiated from a hot piece of metal was measured by radiation pyrometer and the temp was determined as 80 °C. Assuming the surface of emissivity of 0.70 later it was found that the accurate volume of emissivity was 0.65. Find the error in temperature determination.
- (b) Enlist the different types of thermal expansion methods. Explain any one of them with a neat sketch.

5. Attempt any one part : (1 × 10 = 10)

- (a) Water (density: 1000 kgm^{-3}) stored in a cylindrical drum of diameter 1 m is emptied through a horizontal pipe of diameter 0.08 m. A pitot-static tube is placed inside the pipe facing the flow. At the time when the difference between the stagnation and static pressure measured by the pitot-static tube is 9KPa. Find the rate of reduction in water level in the drum.
- (b) Elaborate the working principle of rotameter with a neat sketch.

6. Attempt any one part : (1 × 10 = 10)

- (a) How load cell method is used for weight measurement ? Explain the working of hydraulic load cell with neat diagram.
- (b) Name some of the piezoelectric crystals. Discuss about the piezoelectric transducer for weight measurement.

7. Attempt any two parts : (5 × 2 = 10)

- (a) Write short notes on the thermal drying method.
- (b) Describe about the electrical method of moisture measurement.
- (c) Elucidate about the chemical reaction method for the measurement of moisture.