Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III • EXAMINATION – WINTER 2013

Subject Code: 131403 Date: 28-11-2013

Subject Name: Food Engineering Transport Phenomenon

Time: 02.30 pm - 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)** Answer the followings

1. Write a statement of pascal's law and Derive it. **5**

2. A pipe with diameter 300mm has water (density 1000 $kg.m^{-3}$, viscosity 1mPa.s), flowing through it. Find Reynold's number for the flow when there is flow speed of 3 $mm.s^{-1}$ **2**

(b)

1. Write a short note on : metacentric height **3**

2. Derive the continuity equation for three dimensions. **4**

Q.2 **(a)**

1. Give the classification of pressure measuring device. Derive an equation of pressure difference for differential U-tube manometer. **7**

(b) Define the following terms **7**

1. Meta centre
2. Laminar flow
3. Steady flow
4. Reynold's number
5. Dynamic viscosity
6. Give the range of discharge co-efficient for orifice meter
7. Centre of buoyancy

OR

(b)

1. Draw the figures of different conditions for submerged body. **3**

2. Write in brief about :stream functions. **4**

Q.3 **(a)** Write a short note on : **7**

1. Notches
2. Rotameter

(b) Velocity potential function is given by an expression **4**

1. $Ø= -(xy^3/3) - x^2 + (x^3y/3) + y^2$

(i) Find the velocity components in x and y directions

(ii) Show that Ø represents a possible case of flow

2. Write a short note on: Orifice meter **3**

OR

Q.3 **(a)**

1. One liter of certain oil weighs 0.8 kg, calculate the specific weight, density, specific volume, and specific gravity of it. **3**

2. The velocity distribution within the fluid flowing over a plate is given by **4**

$$u = \frac{3}{4} y - y^2$$

Where, u is the velocity in (m/s) and y is a distance above the plate in (m).Determine the shear stress at y=0 and at y=0.2 m. take that μ=8.4 poise.

(b) If the capillary rise (h) depends upon the specific weight (sp.wt) surface tension (σ) of the liquid and tube radius (r) show that: **7**

$$h = r\phi\left(\frac{\sigma}{sp.wt.* r2}\right)$$

Where , Ø is any function

Q.4 **(a)**

1. Write short note on : Newton's law of viscosity. **3**

2. A large storage tank contains oil having a density of 917 kg/m3. The tank is 3.66 m tall and vented (open) to the atmosphere of 1 atm at the top. The tank is filled with oil to a depth of 3.05 m (10 ft) and also contains 0.61 m (2 ft) of water in the bottom of the tank. Calculate the pressure in Pa and psia at 3.05 m from the top of the tank and at the Bottom . And calculate the gauge pressure at the bottom of the tank. **4**

(b) **3**

1. Prove that $t= 2\Pi (L/g)^{1/2}$ is dimensionally homogeneous equation. Where t=time, L = length of pendulum and g= gravity acceleration

2. Explain centre of buoyancy and buoyant force in brief. **4**

OR

Q.4 **(a)**

1. A simple manometer is used to measure the pressure of oil sp.gr. 0.8 flowing in a pipeline. Its right limb is open to atmosphere and the left limb is connected to the pipe. The center of the pipe is 9.0 cm below the level of the mercury in the right limb. If the difference of the mercury level in the two limbs is 15 cm, determine the absolute and the gauge pressures of the oil in the pipe. **3**

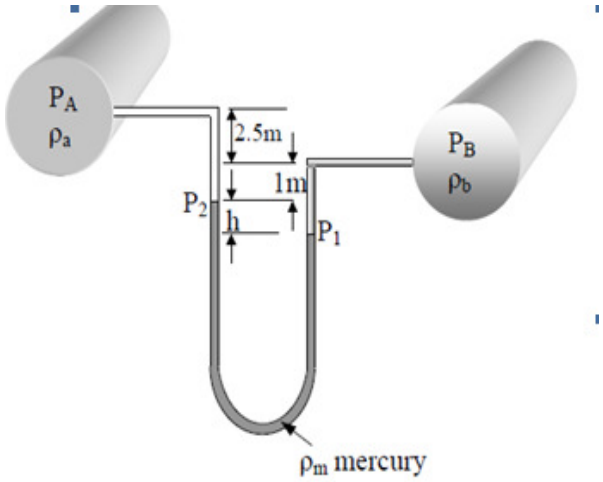
2. What is unit and dimensions. Give importance of units and measurement in detail. **4**

Q.4 **(b)** Write a short note on venturi meter. **7**

Q.5 **(a)** What is diffusion? Explain Fick's law of diffusion in detail. **7**

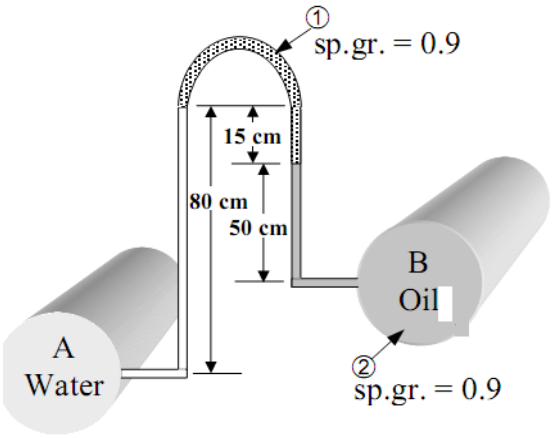
(b) **4**

1. A differential manometer is connected to two pipes as shown in Figure. The pipe A is containing carbon tetrachloride sp.gr. = 1.594 and the pipe B is contain an oil of sp.gr. = 0.8. Find the difference of mercury level if the pressure difference in the two pipes be 0.8 kg/cm2.



2. **3**

An inverted manometer, when connected to two pipes A and B, gives the readings as shown in Figure. Determine the pressure in tube B, if the pressure in pipe A 1.0 kg/cm2.



OR

Q.5 **(a)** **4**

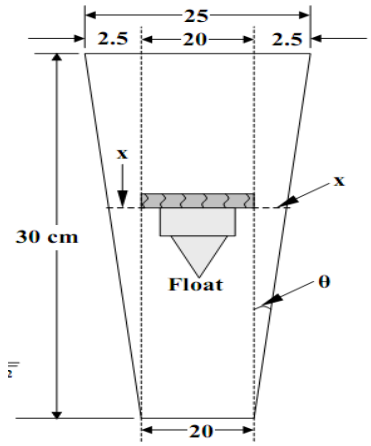
1. A Pitot tube is placed at a center of a 30 cm I.D. pipe line has one orifice pointing upstream and other perpendicular to it. The mean velocity in the pipe is 0.84 of the center velocity (i.e. u/ux =0.94). Find the discharge through the pipe if: -

i- The fluid flow through the pipe is water and the pressure difference between orifice is 6 cm H2O.

ii- The fluid flow through the pipe is oil of sp.gr. = 0.78 and the reading manometer is 6 cm H2O. Take Cp = 0.98.

2. A rectangular notch 2.5 m wide has a constant head of 40 cm, find the discharge over the notch where Cd = 0.62 **3**

(b) A rotameter tube of 0.3 m long with an internal diameter of 25 mm at the top and 20mm at the bottom. The diameter of float is 20 mm, its sp.gr. is 4.8 and its volume is 6 cm3. If the coefficient of discharge is 0.7, what will be the flow rate water when the float is half way up the tube? **7**



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