VIT
Vellore Institute of Technology

Final Assessment Test – November 2019

Course: CHE1005 - Momentum Transfer

Class NBR(s): 1176 Slot: D1+TD1

Time: Three Hours Max. Marks: 100

KEEPING MOBILE PHONE/SMART WATCH, EVEN IN 'OFF' POSITION, IS EXAM MALPRACTICE

Answer any TEN Questions

(10 X 10 = 100 Marks)

1. The water strider bug is supported on the surface of a pond by surface tension acting along the interface between the water and bug's legs. Determine minimum length of this interface needed to support the bug. Assume surface tension of water is 0.0725 N/m and bug's weighs 10^{-4} N. Repeat the above if surface tension were to support a person weighing 750 N.

2. The water in a tank is pressured by air, and the pressure is measured by a multifluid manometer as shown in Fig.1. The tank is located on a mountain at an altitude of 1400 m where the atmospheric pressure is 85.6 kPa. Determine the air pressure in the tank if h_1=0.1 m, h_2 = 0.2 m, and h_3 = 0.35 m. Take densities of water, oil and mercury to be 1000 kg/m^3, 850 kg/m^3 and 13600 kg/m^3 respectively.

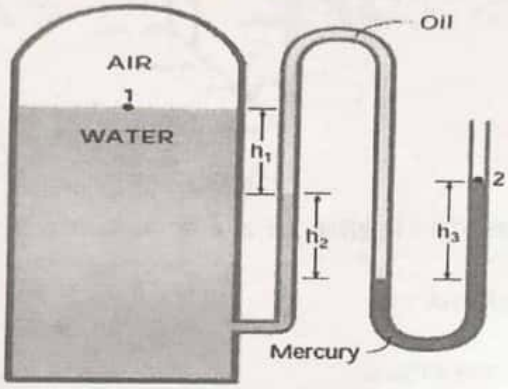

Fig.1

3. A conical tube of length 2 m is fixed vertically with its smaller end upwards as shown in Fig 2. The velocity of flow at the smaller end is 5 m/sec while at the lower end it is 2 m/sec. the pressure head at the smaller end is 2.5 m of liquid. The loss of head at the tube is 0.35 $(v_1-v_2)^2/2g$, where v_1 is the velocity at the smaller end and v_2 at the lower end respectively. Determine the pressure head at the lower end.

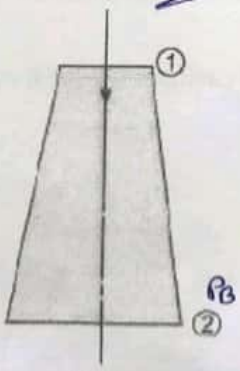

Fig.2.

4. Derive an expression for Bernoulli's equation from first principle and state the assumptions made for such a derivation.

5. A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of oil of specific gravity 0.8. The discharge of oil through venturimeter is 60 litres/sec. Find the reading of the oil mercury differential manometer.

6. A horizontal pipe of diameter 500 mm is suddenly contracted to a diameter of 250 mm. The pressure intensities in the large and smaller pipe is given as 13.734 N/cm^2 and 11.772 N/cm^2 respectively. Find the loss of head due to contraction if C_c = 0.62. Also determine the rate of flow of water.

7. For a town water supply, a main pipe line of diameter 0.4 m is required. As pipes more than 0.35 m diameter are not readily available, two parallel pipes of the same diameter were used for water supply. If the total discharge in the parallel pipes is same as in the single main pipes, find the diameter of the parallel pipe. Assume the coefficient of friction is same for all pipes.

8. Show that the discharge per unit width between two parallel plates distance b apart, when one plate is moving at velocity U while the other one is held stationary, for the condition of zero shear stress at the fixed plate and $q = Ub/3$.

9. A thin rectangular plate having a width w and a height h is located so that it is normal to a moving stream of fluid as shown in Fig. 3. Assume the drag, d, that the fluid exerts on the plate is a function of w and h, the fluid viscosity and density, μ and ρ, respectively and the velocity V of the fluid approaching the plate. Determine a suitable set of pi terms to study this problem experimentally.

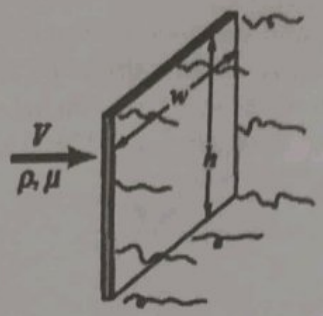

Fig. 3

10. A steel sphere of 4 mm diameter falls in glycerine at a terminal velocity of 0.04 m/sec. Assuming Stoke's law is applicable, determine:
    (i) Dynamic viscosity of glycerine
    (ii) Drag force
    (iii) Drag coefficient for the sphere.

11. A tube of $0.05 m^2$ cross sectional area is packed with spherical particles up to a height of 0.25 m. The porosity of the bed is 0.35. It is desired to fluidize the particles with water. Determine the minimum fluidization velocity.

12. A centrifugal pump delivers water at the rate of 1800 lit/min, to a height of 20m, through a 0.1m, diameter and 80 m long pipe. Find the power required to drive the pump, if the overall efficiency is 65%, and Darcy's friction factor is 0.02.

13. Define cavitation. What are the effects of cavitation? Give the necessary precautions against cavitation.

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