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10CV35

Third Semester B.E. Degree Examination, June/July 2016
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. Distinguish between : i) Ideal fluids and real fluids ii) Surface tension and capillarity **(06 Marks)**

b. Prove that the relationship between surface tension and pressure inside a droplet of liquid in excess of outside pressure is given by, $P = \frac{4\sigma}{d}$. **(06 Marks)**

c. A 400 mm diameter staff is rotating at 200 mm in a bearing of length 120 mm. If the thickness of oil film is 1.5 mm and the dynamic viscosity of the oil is 0.7 N/m^2 determine:
i) Torque required to overcome friction in bearing
ii) Power utilized. **(08 Marks)**

2 a. Differentiate between : i) Absolute and gauge pressure ii) Simple manometer and differential manometer and iii) Piezometer and pressure gauges. **(06 Marks)**

b. What is the difference between U-tube differential manometers and inverted U-tube differential manometers? Where are they used? **(06 Marks)**

c. A single column manometer is connected to a pipe containing oil of specific gravity 0.8. The ratio of reservoir area to the limb is 100. The liquid level in the reservoir is 300 mm below the centre of the pipe containing oil and level of liquid in the right liquid limb is 500 mm above the liquid level in the reservoir. Determine the pressure of liquid in the pipe. The liquid in the reservoir and right limb is mercury with its sp.gr. as 13.6. **(08 Marks)**

3 a. Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid. **(12 Marks)**

b. Find the magnitude and direction of the resultant force due to water acting on a roller gate of cylindrical form of 4 m diameter, when the gate is placed on the dam in such a way that water is just going to spill. Take the length of the gate as 8 m. **(08 Marks)**

4 a. Differentiate between the Eulerian and Lagrangian methods of representing fluid flow. **(06 Marks)**

b. Show that streamlines and equipotential lines form a set of perpendicular lines. **(06 Marks)**

c. In a 2-D incompressible flow, the fluid velocity components are given by $u = x - 4y$ and $v = -y - 4x$. Show that velocity potential exists and determine its form as well as stream function. **(08 Marks)**

PART – B

5 a. Describe venturimeter and find an expression for discharge through ventimeter. **(06 Marks)**

b. The water is flowing through a tapering pipe having diameter 300 mm and 150 mm at section 1 and 2 respectively. The discharge through the pipe is 40 litres/sec. The section 1 is 10 m above the datum and section 2 is 6 m above datum. Find the velocity of pressure at section 2 if that at section 1 is 400 kN/m^2. **(08 Marks)**

c. A pitot tube is inserted in a pipe of diameter 30 cm. The static pressure in the pipe is 10 cm of mercury (vaccum). The stagnation pressure at the centre of the pipe recorded by the pitot tube is 0.981 N/cm^2. Calculate the discharge through the pipe, if the average flow velocity is 0.85 times the central velocity. Take $C_d = 0.98$. **(06 Marks)**

6 a. Distinguish between hydraulic gradient line and energy gradient line. **(06 Marks)**

b. Derive an expression for loss of head due to sudden enlargement in a pipe line. **(06 Marks)**

c. A pipe line of 0.6 m diameter is 1.5 km long. To augment the discharge, another pipeline of the same diameter is introduced parallel to the first in the second half of its length. Find the increase of discharge if $f = 0.04$ and head at the inlet is 30 m. **(08 Marks)**

7 a. Define various hydraulic coefficients of an orifice and derive the relation between them. **(06 Marks)**

b. Differentiate between a large and small orifice. Obtain an expression for discharge through a large rectangular orifice. **(06 Marks)**

c. Water under a constant head of 4.5 m discharges through an external cylindrical mouthpiece of 50 mm diameter and 150 mm long. If C_C for the orifice is 0.6, find (i) the discharge in litres per second and ii) the absolute pressure at the vena antracta. Assume atmospheric pressure to be 10.3 m of water. **(08 Marks)**

8 a. What are the advantages of triangular notch over a rectangular notch? **(06 Marks)**

b. A right angle triangular notch is used for measuring a discharge of 30 lps. An error of 1.5 mm was made while measuring the head over the notch. Calculate the percentage error in estimating the discharge. Take $C_d = 0.62$. **(06 Marks)**

c. A suppressed rectangular weir is constructed across a channel of 0.77 m width with a head of 0.39 m and the crest 0.6 m above the bed of the channel. Estimate the discharge over it. Consider the velocity of approach and assume $C_d = 0.623$. **(08 Marks)**

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