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10CV35

Third Semester B.E. Degree Examination, June/July 2015
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

Note:1. ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. Assume missing data if any, suitably.

PART - A

1 a. Write units and dimensions of power, viscosity and surface tension. **(06 Marks)**

b. What is the pressure corresponding to 25cm column of kerosene of relative density 0.8? What is the equivalent head of mercury corresponding to this pressure? $\gamma_{water} = 9.79 kN/m^3$. **(06 Marks)**

c. A 90N rectangular solid block slides down a 30^0 inclined plane. The plane is lubricated by a 3mm thick film of oil of relative density 0.9 and viscosity 0.8 pa.s. If the contact area is $0.3m^2$ estimate the terminal velocity of the block. **(08 Marks)**

2 a. State and prove Pascal's law. **(06 Marks)**

b. With a illustrative sketch, show relationships between pressures (Absolute, gaugue , vacuum etc). **(06 Marks)**

c. A simple U – tube manometer containing mercury is connected to a pipe in which an oil of specific gravity 0.8 is flowing. The pressure in the pipe is vacuum. The other end of the pipe is open to atmosphere. Find the vacuum pressure in pipe if the difference of mercury (RD = 13.6) level in the two limbs is 200mm and height of oil in the left limb from the centre of the pipe is 150mm below. **(08 Marks)**

3 a. A vertical isosceles triangular gate with its vertex up has a base width of 2m and a height of 1.5m. If the vertex of the gate is 1m below the free water surface, find the total pressure force and the position of the centre of pressure on one side of the plate $\gamma_{water} = 9.79 kN/m^3$. **(10 Marks)**

b. Prove that for a plate kept horizontal in a liquid will have its centroid coinciding with centre of pressure. **(10 Marks)**

4 a. Show that in an inviscid irrotational flow the stream lines and equipotential lines cross each other at right angles. **(06 Marks)**

b. Verify whether $\phi = m \ln x$ is a valid potential function. **(04 Marks)**

c. For the two dimensional flow field given by $u = 4x^3$ and $v = -12x^2y$ evaluate the stream function Ψ and the velocity v at point (1, 2). Take $\Psi = 0$ @ $x = 0$ & $y = 0$. **(10 Marks)**

PART - B

5 a. In a Siphon pipe installed in a tank, the velocity of flow in the pipe is 5m/s. Taking the atmospheric pressure head as 10.3m and the vapour pressure head as 0.2m. Calculate the maximum height measured above the tank water surface at which the summit can be located without the Siphon action being disrupted (neglect friction and other losses). **(06 Marks)**

b. Write the assumptions in Bernoulli's equation. **(04 Marks)**

c. A pipe of 300mm diameter is conveying $0.3m^3/s$ of water has a right angled bend in horizontal plane. Find the resultant force exerted on the bend if the pressure at inlet and outlet of the bend are 24.525×10^4 p.a and 23.544×10^4 p.a respectively. **(10 Marks)**

6 a. A horizontal pipe of diameter D_1 has a sudden expansion to a diameter D_2. At what ratio D_1/D_2 would the differential pressure on either side of the expansion be maximum? What is the corresponding loss of head differential pressure head? **(12 Marks)**

b. A 0.5m diameter and 100m long pipeline carrying $0.5m^3/s$ of water is fitted with a valve at the downstream end. Calculate the rise of pressure caused within the pipe due to valve closure if i) instantaneously and ii) in 1 second. Assume sonic velocity as 1430 m/s. **(08 Marks)**

7 a. A pitot tube is inserted in a pipe of 300mm diameter. The static pressure of the tube is 100mm of mercury vacuum. The stagnation pressure at the centre of pipe recorded by the pitot tube is $1 \times 10^{-4} N/mm^2$. Calculate the rate of flow of water through the pipe. If the mean velocity of flow is 0.85 times the central velocity. Assume coefficient of the tube to be 0.98. $\gamma_{water} = 9.79kN/m^3$. **(10 Marks)**

b. With a neat sketch, explain vertical staff gauge and sectional staff gauge. **(10 Marks)**

8 a. A 300mm × 150mm venturimeter is provided in a vertical pipe line carrying oil of Sp gravity 0.9,flow being upwards. The difference in elevation of the throat section and entrance section of the venturimeter is 300mm. The differential U – tube manometer shows a deflection of 250mm. Calculate i) the discharge of oil ii) pressure difference between entrance and throat section. Coefficient of meter = 0.98 and specific gravity of mercury = 13.6. **(12 Marks)**

b. A rectangular notch 40cm long is used for measuring a discharge of 30 lps. An error of 1.5mm was made while measuring the head over the notch. Calculate the percent error in the discharge $C_d = 0.6$. **(08 Marks)**

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