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Third Semester B.E. Degree Examination, July/August 2021 Fluid Mechanics

Time: 3 hrs.

Max. Marks: 100

**Note: 1. Answer any FIVE full questions.
2. Assume any missing data suitably and mention about it.**

1.
 - a. Explain the concept of fluid continuum. (04 Marks)
 - b. Define the terms and give their units in S.I. system.
 - i) Mass density ii) Weight density iii) Specific gravity iv) Specific volume
 - v) Surface tension vi) Viscosity. (09 Marks)
 - c. The capillary rise in a glass tube used for measuring water level is not to exceed 0.5mm. Determine its minimum size. Given that the surface tension for water in contact with air = 0.07112 N/m. (07 Marks)

2.
 - a. State and prove hydrostatic law. (06 Marks)
 - b. Differentiate between absolute pressure, gauge pressure and vacuum pressure with the help of an indicative diagram. (06 Marks)
 - c. The right limb of a simple U-tube manometer containing mercury is open to atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The center of the pipe is 12cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20cm. (08 Marks)

3.
 - a. Derive an expression for total pressure and center of pressure on an inclined plane surface immersed in liquid. (10 Marks)
 - b. A lock gate 15m high and 7.5m wide is hinged horizontally at the bottom and maintained in vertical position by a horizontal chain at top. Sea water stands upto a depth of 10m on one side and 7.5m on the other. Find the total tension in the chain. Specific gravity of sea water is 1.03. (10 Marks)

4.
 - a. With the help of sketches, explain Lagrangian and Eulerian methods of describing fluid flow. (04 Marks)
 - b. Calculate velocity component V, given $u = \frac{2}{3}xy^3 - x^2y$ so that the equation of continuity is satisfied. (08 Marks)
 - c. Derive the general equation of continuity in three dimensional forms. (08 Marks)

5.
 - a. State and prove Bernoulli's theorem for motion of fluid along a stream line, starting from Euler's equation. (06 Marks)
 - b. 250 liters per second of water is flowing in a pipe having diameter 300mm. If the pipe is bent by 135°, find the magnitude and direction of the force on the bend. The pressure of water flowing is 400kN/m². Take specific weight of water as 9.81kN/m³. (10 Marks)
 - c. List all the forces acting on a fluid in motion, which of these are considered in Euler's equation. (04 Marks)



- 6 a. Draw a neat labeled sketch of an orificemeter. (04 Marks)
b. Derive an expression for rate of flow through venturimeter. (08 Marks)
c. A venturimeter has its axis vertical. The inlet and throat diameters are 150mm and 75mm respectively. The throat is 225mm above the inlet. Petrol of specific gravity 0.78 flows up through the venturimeter at a rate of 29 liters per second. Find the pressure difference between the inlet and the throat. Take $C_d = 0.96$. (08 Marks)
- 7 a. What is a mouth piece and how are they classified? (06 Marks)
b. Define hydraulic coefficients C_c , C_v and C_d and derive their inter-relationship. (06 Marks)
c. A jet of water issuing from an orifice 25mm diameter under a constant head of 1.5m falls 0.915m vertically before it strikes the ground at a distance of 2.288m measured horizontally from the vena contracta. The discharge was found to be 102 lpm. Calculate the hydraulic coefficients of the orifice. (08 Marks)
- 8 a. What are notches? How are they classified? (06 Marks)
b. Derive an expression for discharge over a V-notch. (08 Marks)
c. A cipolletti weir has a crest length of 0.25m. If the head on the crest is 0.15m, calculate the discharge flowing over it. Take $C_d = 0.64$. (06 Marks)
- 9 a. Derive Darcy-Weisbach equation for headloss in pipes due to friction. (08 Marks)
b. Which are the major and minor losses in pipe flows? (04 Marks)
c. A water distribution network is an equilateral triangle 'ABC' in shape. If the inflow at junction 'A' is 60 units and the outflow at junctions 'B' and 'C' are 40 and 20 units respectively, find the discharge in each pipe. Take initial value of discharge from 'A' to 'B' as 15 units. Take value of 'r' in expression $h_f = r.Q^n$ as for AB:4, for BC:1 and CA:2. Take $n = 2$. (08 Marks)
- 10 a. Explain the phenomenon of water hammer in pipe flow. (04 Marks)
b. Derive an expression for pressure rise inside a pipe due to gradual closure of valve. (08 Marks)
c. A pipeline consists of 3 pipes in series:
i) 300m long 15cm diameter
ii) 150m long 10cm diameter
iii) 240m long 20cm diameter.
The pipeline takes off from a reservoir with water at an elevation of +500m. The elevation at the exit is +400m. Find the discharge in the pipe. Neglect minor losses. Take $f = 0.04$. (08 Marks)

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