CBCS SCHEME

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15CV33

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

Note: **1.** ***Answer any FIVE full questions, choosing one full question from each module.***
2. ***Missing data may be assumed suitably.***

Module-1

1 a. Calculate the capillary rise in a glass tube of 2.5 mm diameter when immersed vertically in (i) water and (ii) mercury. Take surface tension $\sigma = 0.0725$ N/m for water and $\sigma = 0.50$ N/m for mercury in contact with air. Take specific gravity of mercury as 13.6 and angle of contact = 128°. **(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 $p = 4\sigma/d$. **(04 Marks)**

c. A rectangular plate 0.50m × 0.50m dimensions having a weight 500N slides down an inclined plane [Fig.Q1(c)] making 30° angle with the horizontal at a velocity of 1.75 m/sec. If the 2 mm gap between the plate and inclined surface is filled with a lubricating oil, find its viscosity.

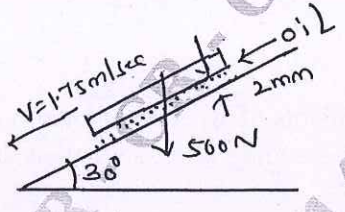

Fig.Q1(c) **(06 Marks)**

OR

2 a. State and prove Pascal's law. **(08 Marks)**

b. Explain with neat sketch: (i) Absolute pressure (ii) Vacuum pressure (iii) Gauge pressure **(05 Marks)**

c. The right limb of a simple U tube manometer containing mercury is open to the atmospheric while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of the pipe is 12 cm 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 20 cm. **(03 Marks)**

Module-2

3 a. Show that centre of pressure lies below the centre of gravity in vertical plane surface submerged in liquid. **(08 Marks)**

b. A gate closing an opening is triangular in section as shown in Fig.Q3(b). The gate is 1m long (in the direction perpendicular to the plane of the paper) and it is made up of concrete weighing 24 kN/m^3. If the gate is hinged at the top and freely supported at one of the bottom ends, find the height of water h on the upstream side when the gate will just be lifted.

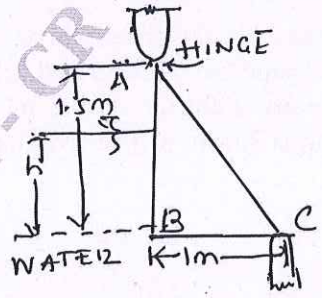

Fig.Q3(b) **(08 Marks)**

OR

4 a. Derive continuity equation in 3 dimensional flow in Cartesian coordinates. **(08 Marks)**

b. The velocity components in a two dimensional flow field for an incompressible fluid are expressed as $U = y^3/3 + 2x - x^2y$, $V = xy^2 - 2y - x^3/3$.

i) Show that these functions represent a possible case of fluid flow.

ii) Obtain an expression for stream functions τ. **(08 Marks)**

Module-3

5 a. State and derive modified Bernoulli's equation. **(08 Marks)**

b. A venture meter is to be fitted in a pipe 0.25 m diameter where the pressure head is 7.6 m of flowing liquid and the maximum flow is 8.1 m^3 per minute. Find the least diameter of the throat to ensure that the pressure head does not become negative. Take $C_d = 0.96$. **(08 Marks)**

OR

6 a. The water is flowing through a pipe having diameter of 20 cm and 10 cm at sections 1 and 2 respectively. The rate of flow through the pipe is 30 litres/sec. The section 1 is 3m above datum and section 2 is 2m above datum. If the pressure at section 1 is 25 N/cm^2, find the intensity of pressure at section 2. **(08 Marks)**

b. A 45° reducing bend is connected in a pipe line, the diameters at the inlet and outlet of the bend being 600 mm and 300 mm respectively. Find the force exerted by water on the bend if the intensity of pressure at inlet to bend is 8.829 N/cm^2 and rate of flow of water is 600 lit/sec. **(08 Marks)**

Module-4

7 a. What are hydraulic coefficients of an orifice? Derive necessary expressions. **(08 Marks)**

b. For a Borda's mouthpiece (running free), show that the coefficient of contraction is 0.5. **(08 Marks)**

OR

8 a. Derive the expression for discharge over a triangular notch. **(08 Marks)**

b. A Cipo letti weir of crest length 60 cm discharge water. The head of water over the weir is 360 mm. Find the discharge over the weir if the channel is 80 cm wide and 50 cm deep. Take $C_d = 0.60$. **(08 Marks)**

Module-5

9 a. Derive Darcy-Weisbach equation for head loss due to friction in a pipe. **(08 Marks)**

b. Three pipes of lengths 800 m, 500 m and 400 m and of diameters 500 mm, 400 mm and 300 mm respectively are connected in series. These pipes are to be replaced by a single pipe of length 1700 m. Find the diameter of the single pipe. **(05 Marks)**

c. Find the loss of head when a pipe of diameter 200 mm is suddenly enlarged to a diameter of 400 mm. the rate of flow of water through the pipe is 250 liters/s. **(03 Marks)**

OR

10 a. Explain water hammer. Derive the expression for water hammer due to sudden closure of valve and pipe is rigid. **(08 Marks)**

b. A main pipe divides into two parallel pipes which again forms one pipe. The length and diameter for the first parallel pipe are 2000 m and 1.0 m respectively, while the length and diameter of 2nd parallel pipe are 2000 m and 0.8 m. Find the rate of flow in each parallel pipe, if total flow in the main is 3.0 m^3/s. The coefficient of friction for each parallel pipe is same and equal to 0.005. **(08 Marks)**

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