CBCS SCHEME

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15CV33

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define the following with units:
i) Mass Density ii) Specific gravity iii) Dynamic viscosity iv) Surface tension. **(06 Marks)**

b. Derive an expression for capillary rice in a liquid in the form $h = \frac{4\sigma}{\rho g d}$ with usual notations. **(04 Marks)**

c. If the velocity profile of a fluid over a plate is a parabolic with the vertex 20cm from the plate, where the velocity is 120cm/sec. Calculate the velocity gradients and shear stress at a distance of zero and 10cm from the plate assuming the viscosity of the fluid as $0.85 NS/m^2$. **(06 Marks)**

OR

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

b. Explain the working of a Bourdan's pressure gauge with a sketch. **(04 Marks)**

c. A single column manometer is connected to a pipe containing a liquid of specific gravity 0.9 as shown in Fig.Q.2(c). Find the pressure in the pipe if the area of the reservoir is 100 times the area of the tube for the manometer reading shown in Fig.Q.2(c). The specific gravity of heavier liquid is 13.6. **(06 Marks)**

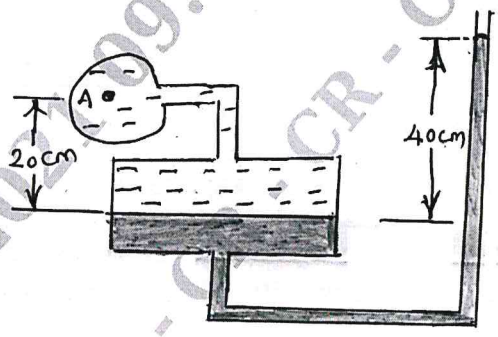

Fig.Q.2(c)

Module-2

3 a. Derive an expression for total pressure and centre of pressure on a vertically immersed plane surface. **(08 Marks)**

b. The stream function for a two dimensional flow is given by $\psi = 2xy$. Determine the velocity at point P(2, 3). Also find the velocity potential. **(06 Marks)**

c. What is flow net? Mention two uses of flow nets. **(02 Marks)**

OR

4 a. A rectangular plane surface 1m wide and 3m deep lies in water in such a way that its plane makes an angle of 30° with the free surface of water. Determine the total pressure and the depth of centre of pressure when the upper edge of the plate is 2m below the free surface. **(06 Marks)**

b. Explain:
i) Steady and unsteady flow
ii) Rotational and irrotational flow
iii) Laminar and turbulent flow. **(06 Marks)**

c. The following case represents the two velocity components. Determine the third component of velocity such that they satisfy continuity equation - $v = 2y^2$, $w = 2xyz$. **(04 Marks)**

Module-3

5 a. Define momentum equation and give its applications. **(03 Marks)**

b. Derive the Bernoulli's equation starting from Euler's equation of motion with a neat sketch. **(06 Marks)**

c. A pipe of diameter 400mm carries water at a velocity of 20m/s. The pressures at the points E and F are given as 29N/cm^2 and 22N/cm^2 respectively while the datum head at E and F are 18m and 20m. Find the loss of head between E and F. **(07 Marks)**

OR

6 a. Derive an expression for discharge through venturimeter. **(05 Marks)**

b. Water flows at the rate of 0.147m^3/s through a 150mm diameter orifice inserted in a 300mm diameter pipe. If the pressure gauges fitted upstream and downstream of the orifice plate have shown readings of 176.58kN/m^2 and 88.29kN/m^2 respectively, find the coefficient of discharge 'C' of the orifice meter. **(05 Marks)**

c. A 45° reducing bend is connected in a pipe line, the diameter at the inlet and outlet of the bend being 600mm and 300mm respectively. Determine the force exerted by water on the bend if the intensity of pressure at inlet to bend is 8.829×10^4N/m^2 and rate of flow of water is 600 litre/s. **(06 Marks)**

Module-4

7 a. Define the hydraulic coefficients (C_c, C_d, C_v) for an orifice and obtain a relation between them. **(04 Marks)**

b. Show that the side slopes in a Cipolleti notch is $\tan \theta/2 = 1/4$, to reduce end contractions. **(07 Marks)**

c. Mention two advantages of triangular notch over rectangular notch. Find the discharge over a triangular notch of angle 60° when the head over the V-notch is 0.3m. Assume $C_d = 0.6$. **(05 Marks)**

OR

8 a. Explain how do you classify the mouth piece and show that discharge for Borda's mouth piece running free, $Q = 0.5a\sqrt{2g}\,\bar{h}$ with usual notations. **(06 Marks)**

b. Explain ventilation of Weir's. **(04 Marks)**

c. A broad crested weir of 50m length has 50cm height of water above its crest. Find the maximum discharge i) neglecting velocity of approach ii) Considering velocity of approach, when the channel has a cross sectional area of 50m^2 on the upstream side. **(06 Marks)**

Module-5

9 a. Derive Darcy Weisbach expression for the loss of head due to friction in pipes. **(06 Marks)**

b. Three pipes of lengths 1000m, 800m and 500m and diameters 500mm, 400mm and 300mm respectively are connected in series. These pipes are to be replaced by a single pipe of length 2300m. Find the diameter of the single pipe. **(04 Marks)**

c. At a sudden enlargement of water main from 240mm to 480mm diameter, the hydraulic gradient rises by 10mm. Determine the rate of flow. **(06 Marks)**

OR

10 a. Explain the terms hydraulic gradient and total energy line. **(04 Marks)**

b. Derive the expression for pressure rise due to sudden closure of the valve when the pipe is rigid. **(04 Marks)**

c. For a pipe network shown in Fig.Q.10(c), determine the flow in each pipe. The value of 'n' may be assumed as 2.0. **(08 Marks)**

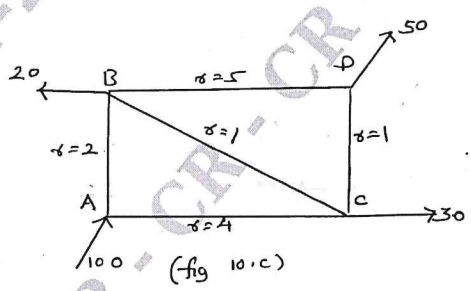

Fig.Q.10(c)

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