CBCS SCHEME

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15CV33

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define the following terms. Mention their units and dimensions.
(i) Mass density (ii) Weight density (iii) Specific volume (iv) Specific gravity **(08 Marks)**

b. A U tube manometer is used to measure the pressure of oil of specific gravity 0.85 flowing in a pipe line. Its left end is connected to the pipe and right limb is open to atmosphere. The center of the pipe is 100 mm below the level of mercury (Sp.Gr = 13.6). In the right limb. If the difference of mercury levels in the right limb and left limb is 160 mm, determine the absolute pressure of oil in the pipe. **(08 Marks)**

OR

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

b. A 400 mm shaft is rotating at 200 rpm in a bearing of length 100 mm. If the thickness of the oil film is 1.4 mm and the dynamic viscosity of the oil is 0.7 N-S/m^2. Determine
(i) Torque required to overcome friction in bearing.
(ii) Power utilized in overcoming viscous resistance.
Assume a linear velocity profile. **(08 Marks)**

Module-2

3 a. Derive an expression for total pressure on one side of an inclined plane and show that the center of pressure lies lower than its centroid. **(08 Marks)**

b. If for a two dimensional potential flow, the velocity potential is given by $\phi = x(2y-1)$. Determine the velocity at the point P(4, 5). Determine also the value of stream function ψ at the point P. **(08 Marks)**

OR

4 a. Obtain an expression for continuity equation in three dimensional form. **(08 Marks)**

b. A vertical Gate closes a horizontal tunnel 5 m high and 3 m wide running full with water. The pressure at the bottom of the gate is 196.20 kN/m^2. Determine the total pressure on the gate and position of the centre of pressure. **(08 Marks)**

Module-3

5 a. Obtain Euler's equation of motion along a stream tube and hence derive Bernoulli's equation. List out the assumptions made. **(08 Marks)**

b. A horizontal venutrimeter with inlet diameter of 25 cm and throat diameter of 15 cm is used to measure. The flow of water. The pressure at the throat is 30 cm of mercury (vaccum) and that at the inlet is 200 KN/m^2 (gauge). Find the discharge of water through the meter. Take $C_d = 0.98$. **(08 Marks)**

OR

6 a. Derive the equation for the discharge through venturimeter. List out the assumptions made. **(08 Marks)**

b. A 300 mm diameter pipe carries water under a head of 20 m, with a velocity of 3.5 m/s. If the axis of the pipe turns through 45°, find the magnitude and direction of the resultant force at the bend. **(08 Marks)**

Module-4

7 a. Define various hydraulic coefficients of an orifice and derive the relation for discharge through an orifice. **(08 Marks)**

b. A rectangular notch 40 cm long 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 percent error in the discharge $C_d = 0.6$ **(08 Marks)**

OR

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

b. A rectangular orifice 1.5 m wide and 1.0 m deep is discharging water form a tank. If the water level in the tank is 3 m above the top edge of the orifice, find the discharge through the orifice. Take $C_d = 0.6$ **(08 Marks)**

Module-5

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

b. A compound piping system consists of 1800 m of 0.5 m, 1200 m of 0.4 m and 600 m of 0.3 m new cast iron pipes connected in series. Convert the system to,

(i) An equivalent length of 0.4 m pipe.

(ii) Equivalent size pipe 3600 m long. **(08 Marks)**

OR

10 a. Water is flowing in a pipe of 150 mm diameter with a velocity of 2.5 m/s. When it is suddenly brought to rest by closing the valve. Find the pressure rise assuming the pipe is elastic, given $E = 200\,GN/m^2$, Poisson's ratio 0.25 and K for water = $2\ GN/m^2$, pipe wall is 5 mm thick. **(08 Marks)**

b. Write short notes on: (i) Minor losses in pipe flow (ii) Hardy cross method (iii) Water hammer in pipes. **(08 Marks)**

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