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CBCS SCHEME

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15MT42

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Fluid Mechanics & Machines

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 fluid properties and give their units :
(i) Specific weight.
(ii) Surface tension.
(iii) Kinematic viscosity.
(iv) Specific gravity **(06 Marks)**

b. State and prove the Pascal's law. **(06 Marks)**

c. An open tank contains water upto a depth of 2 m and above it an oil of specific gravity 0.9 for a depth of 1 m. Find the pressure intensity :
(i) At the interface of two liquids and (ii) at the bottom of the tank. **(04 Marks)**

OR

2 a. Derive an expression for the force exerted on a submerged vertical plane surface by the static liquid and locate the position of centre of pressure. **(08 Marks)**

b. A rectangular plane surface 3 m wide and 4 m 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 force and position of centre of pressure, when the upper edge is 2 m below the free surface. **(08 Marks)**

Module-2

3 a. Derive continuity equation, for three dimensional flows. **(08 Marks)**

b. A fluid flow field is given by, $V = x^2yi + y^2zj - (2xyz + yz^2)k$. Prove that it is a case of possible steady incompressible fluid flow. Calculate the velocity and acceleration at the point (2, 1, 3) **(08 Marks)**

OR

4 a. State and prove Bernoulli's equation from first principle and mention the assumptions made. **(08 Marks)**

b. A pump has a tapering pipe running full of water. The pipe is placed vertically with the diameters at the base and top being 1.2 m and 0.6 m respectively. The pressure at the upper end is 240 mm of Hg vacuum, while the pressure at the lower end is 15 kN/m^2. Assume the head loss to be 20% of difference of velocity head. Calculate the discharge when the flow is vertically upwards and the difference of elevation is 3.9 m. **(08 Marks)**

Module-3

5 a. The efficiency 'η' of a fan depends on density 'ρ', dynamic viscosity 'μ' of the fluid, angular velocity 'ω', diameter D of the rotor and the discharge Q. Express η in terms of dimensionless parameters. **(08 Marks)**

b. Explain the following:
(i) Mach's number. (ii) Weber's number.
(iii) Froude's number. (iv) Reynold's number. **(08 Marks)**

OR

6 a. Derive an expression for rate of flow through venturimeter. **(08 Marks)**

b. List out the advantages of V-notch. **(02 Marks)**

c. Water flows over a rectangular weir 1 m wide at a depth of 150 mm and afterwords passes through a triangular right-angled weir. Taking $[C_d]$for the rectangular and triangular weir as 0.62 and 0.59 respectively. Find the depth over the triangular weir. **(06 Marks)**

Module-4

7 a. Derive Euler's turbine equation and state the assumptions made. **(06 Marks)**

b. Show that the alternate form of Euler's turbine equation can be expressed as follows :

$$W = \frac{\left(v_1^2 - v_2^2\right) + \left(u_1^2 - u_2^2\right) + \left(v_{r_2}^2 - v_{r_1}^2\right)}{2}$$ **(06 Marks)**

c. List out the classification of turbomachines. **(04 Marks)**

OR

8 a. Define a turbomachine. Explain the schematic diagram showing principal parts of a turbo machine. **(04 Marks)**

b. Compare a turbomachine and a positive displacement machine. **(04 Marks)**

c. For a radial flow turbomachine show that degree of reaction, $R = \frac{2 + \cot\beta_2}{4}$, where β_2 = discharge blade angle. **(08 Marks)**

Module-5

9 a. Draw the inlet and exit velocity triangles for a pelton wheel turbine. Obtain the expression for maximum hydraulic efficiency. **(08 Marks)**

b. The internal and external diameters of an inward flow reaction turbine are 1.2 m and 0.6 m respectively. The head on turbine is 22 m and velocity of flow through the runner is constant and is equal to 2.5 m/s. The guide blades angle is 10° and the runner vanes are radial at inlet. If the discharge at outlet is radial.
Find : (i) Speed of turbine. (ii) Vane angle at outlet (iii) Hydraulic efficiency (η_H)
Draw velocity triangles. **(08 Marks)**

OR

10 a. With sketches explain velocity and pressure compounding. **(08 Marks)**

b. A simple impulse turbine has wheel of 30 cm diameter and runs at 200 rps. The nozzles are inclined at 20° to plane of wheel and exit velocity of steam from nozzle is 850 m/s. Loss of velocity in blades is 10% and blades are symmetrical. Determine
(i) Blade angles
(ii) Blade efficiency
(iii) Absolute velocity at exit. **(08 Marks)**

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