CBCS SCHEME

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18MT42

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Fluid Mechanics and Machines

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define the following:
i) Viscosity
ii) Specific gravity
iii) Weight density
iv) Real fluid
v) Newtonian fluid. **(10 Marks)**

b. State and prove Pascal's law. **(10 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. **(10 Marks)**

b. A rectangular plane surface 2m 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 position of centre of pressure when the upper edge is 1.5m below the free water surface. **(10 Marks)**

Module-2

3 a. Explain the types of fluid flow. **(08 Marks)**

b. Derive continuity equation for the 3 dimensional flow. **(12 Marks)**

OR

4 a. With assumptions explain Bernoulli's equation from Euler's equation. **(08 Marks)**

b. The water is flowing through a pipe having diameter 20cm and 10cm at section 1 and 2 respectively. The rate of flow through pipe is 35 litres/sec. The section 1 is 6m above datum and section 2 is 4m above datum. If the pressure at section 1 is 39.24N/cm^2. Find the intensity of pressure at section 2. **(12 Marks)**

Module-3

5 a. The frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by $T = D^5N^2\rho\phi\left[\frac{M}{D^2N\rho}\right]$. Prove this by the method of dimensions. **(12 Marks)**

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

OR

6 a. Derive an expression for rate of flow through orifice meter or orifice plate. **(10 Marks)**

b. A horizontal venturimeter with inlet diameter 20cm and throat diameter 10cm is used to measure the flow of oil of sp gr 0.8. The discharge of oil through venturimeter is 60 liters/sec. Find the readings of the oil-mercury differential manometer. Take $C_d = 0.98$. **(10 Marks)**

Module-4

7 a. Explain the difference between positive displacement machines and turbo machines. **(08 Marks)**

b. List the classification of turbomachines. **(06 Marks)**

c. Define:

i) Dimensional homogeneity

ii) Buckingham's π theorem. **(06 Marks)**

OR

8 a. Derive Euler's turbine equation and state the assumptions made. **(10 Marks)**

b. In a mixed flow turbomachine the fluid enters such that the absolute velocity is axial at inlet and at outlet relative velocity is radial. What is the degree of reaction and energy input to the fluid, if relative velocity at outlet is same as tangential blade speed at inlet? The following data may be used:

i) Inlet diameter = 16cm

ii) Exit diameter = 50cm

iii) Speed = 3000rpm

iv) Blade angle at inlet = 45°. **(10 Marks)**

Module-5

9 a. Define Hydraulic turbines. Explain the classification of hydraulic turbines. **(10 Marks)**

b. Draw the inlet and exit velocity triangles for pelton wheel turbine. Obtain the expression for maximum hydraulic efficiency. **(10 Marks)**

OR

10 a. Explain velocity and pressure compounding of steam turbines. **(10 Marks)**

b. Steam issuing from a nozzle to a De-Laval turbine with a velocity of 1000m/s. The nozzle is 20°. The mean blade speed is 400m/s. The blades are symmetrical, the mass flow rate = 1000kg/hr, friction factor = 0.8, nozzle efficiency = 0.95. Calculate: i) The blade angles ii) Axial thrust iii) Work done per kg of steam iv) Power developed v) Blade efficiency vi) Stage efficiency. **(10 Marks)**

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