CBCS SCHEME

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18MT42

Fourth Semester B.E. Degree Examination, Feb./Mar.2022
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 properties of fluids with their units:
(i) Specific Gravity
(ii) Viscosity
(iii) Surface tension
(iv) Specific weight **(08 Marks)**

b. Explain the different types of fluids. **(04 Marks)**

c. Find the kinematic viscosity of an oil having density 981 kg/m^3. The shear stress at a point in oil is 0.245 N/m^2 and velocity gradient at that point is 0.2 per second. **(08 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 2 m wide and 3 m deep lies in water in such a way that its plane makes an angle of 30° with the free surface of water. Determine total pressure and position of centre of pressure when the upper edge is 1.5 m below the free water surface. **(10 Marks)**

Module-2

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

b. Explain different types of fluid flow. **(04 Marks)**

c. The velocity components in a 2-D flow field for an incompressible fluid are as follows: $u = \frac{y^3}{3} + 2x - x^2y$ and $v = xy^2 - 2y - \frac{x^3}{3}$. Obtain an expression for the stream function ψ **(08 Marks)**

OR

4 a. Derive Euler's equation of motion for ideal fluids and hence derive Bernoulli's equation. **(10 Marks)**

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

Module-3

5 a. Explain in brief about the following dimensionless number,
(i) Euler's number (ii) Reynold's number (iii) Mach number **(06 Marks)**

b. 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 $T = D^5N^2\rho\phi\left[\frac{\mu}{D^2N\rho}\right]$.
Prove this by the method of dimensions. **(14 Marks)**

OR

6 a. Derive an expression for discharge through venturimeter. **(10 Marks)**

b. An orifice meter with orifice diameter 15 cm is inserted in a pipe of 30 cm diameter. The pressure difference measured by a mercury oil differential manometer on the 2 sides of the orifice meter gives a reading of 50 cm of mercury. Find the rate of flow of oil of sp.gr.0.9 when the co-efficient of discharge of the orifice meter = 0.64. **(10 Marks)**

Module-4

7 a. Define turbo machine and with a neat sketch, explain the parts of turbomachines. **(08 Marks)**

b. Derive Euler turbine equation and explain alternate form of Euler turbine equation. **(12 Marks)**

OR

8 a. Explain the classification of turbomachines. **(08 Marks)**

b. At a 50% reaction stage axial flow turbine, the mean blade diameter is 60 cm. The maximum utilization factor is 0.9 steam rate is 10 kg/s. Calculate the inlet and outlet absolute velocities and power developed if the speed is 2000 rpm. **(12 Marks)**

Module-5

9 a. Derive the maximum efficiency of Pelton turbine. **(10 Marks)**

b. A Kaplan turbine produces 80,000 HP (58,000 KW) under a head of 25 m which has an overall efficiency of 90%. Taking the value of speed ratio $\phi = 1.6$, flow ratio $\psi = 0.5$ and the hub diameter = 0.35 times the outer diameter. Find the diameter and speed of the turbine. **(10 Marks)**

OR

10 a. Briefly explain :

(i) Velocity compounding of impulse turbine

(ii) Pressure compounding of impulse turbine. **(12 Marks)**

b. Explain the following:

(i) Stage efficiency.

(ii) Need for compounding **(08 Marks)**

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