CBCS SCHEME

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15MT42

Fourth Semester B.E. Degree Examination, Feb./Mar. 2022
Fluid Mechanics and Machines

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Explain the phenomenon of capillarity. Obtain an expression for capillary rise of liquid. **(06 Marks)**

b. Explain the terms: i) Dynamic viscosity ii) Kinematic viscosity. Give their dimensions. **(04 Marks)**

c. Define surface tension. Prove that the relationship between surface tension and pressure inside droplet of liquid in excess of outside pressure is given by $P = \frac{4\sigma}{d}$. **(06 Marks)**

OR

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

b. The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of the pipe is 12cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20cm. **(08 Marks)**

Module-2

3 a. Distinguish between:
i) Steady and Un-steady flow
ii) Uniform and Non-Uniform flow
iii) Compressible and incompressible flow
iv) Laminar and turbulent flow. **(08 Marks)**

b. Define the equation of continuity. Obtain an expression for a three-dimensional steady incompressible flow. **(08 Marks)**

OR

4 a. What is Euler's equation of motion? How will you obtain Bernoull's equation from it? **(08 Marks)**

b. A non-uniform part of a pipe line 5m long is laid at a slope of 2 in 5. Two pressure gauges each fitted at upper and lower ends read 20N/cm^2 and 12.5N/cm^2. If the diameters at the upper and lower ends are 15cm and 10cm respectively. Determine the quantity of water flowing per second. **(08 Marks)**

Module-3

5 a. Define the following non-dimensional numbers:
   i) Reynold's number
   ii) Froude's number
   iii) Mach's number
   iv) Weber's number. **(08 Marks)**

   b. i) State Buckingham's π-theorem.
   ii) The efficiency "η" of a fan depends on density "ρ", dynamic viscosity "μ" of the fluid, angular velocity "w", diameter "D" of the rotor and the discharge "Q". Express η in terms of dimensionless parameters. **(08 Marks)**

OR

6 a. What is Venturimeter? Derive an expression for the discharge through a venturimeter. **(08 Marks)**

   b. The head of water over a rectangular notch is 900mm. The discharge is 300 litres/s. Find the length of the notch, when $C_d = 0.62$. **(08 Marks)**

Module-4

7 a. Define Turbomachine. Mention its important parts with neat sketch. **(08 Marks)**
   b. Distinguish between Turbomachine and positive displacement machine. **(08 Marks)**

OR

8 a. Derive alternative form of Euler's turbine equation. **(08 Marks)**
   b. Define the terms degree of reaction (R) and Utilization factor (∈). **(08 Marks)**

Module-5

9 a. Explain different efficiencies of hydraulic turbines. **(08 Marks)**
   b. In a power station, a Pelton wheel produces 15500kW under a head of 350m while running at 500rpm. Assume a turbine efficiency of 0.84, coefficient of velocity for nozzle as 0.98, speed ratio 0.46 and bucket velocity coefficient 0.86, calculate: i) Number of jet ii) Diameter of each jet iii) Tangential force on the buckets if the bucket deflect the jet through 165°. **(08 Marks)**

OR

10 a. Prove that the maximum blade efficiency with equiangular blades for impulse turbine is $(\eta_b)_{max} = \cos^2 \alpha_1$. **(08 Marks)**

   b. Define:
   i) Blade efficiency
   ii) Nozzle efficiency
   iii) Stage efficiency for impulse steam turbine
   iv) Diagram efficiency. **(08 Marks)**

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