CBCS SCHEME

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15MT42

Fourth Semester B.E. Degree Examination, Aug./Sept. 2020
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. Define following terms with SI units : (i) Dynamic viscosity (ii) Surface tension (iii) Mass density (iv) Vapour pressure (v) Specific gravity. **(05 Marks)**

b. State and prove Pascal's law. **(05 Marks)**

c. 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 pipe is 12 cm 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 20 cm. **(06 Marks)**

OR

2 a. State and prove hydrostatic law. **(05 Marks)**

b. Derive an expression for force exerted on a submerged vertical plane surface by the static liquid and locate the position of centre of pressure. **(06 Marks)**

c. A circular plate 3 m diameter is submerged in water as shown in Fig. Q2 (c). Its greatest and least depths are below the surface being 2 m and 1 m respectively. Find : (i) The total pressure on front face of the plate and (ii) the position of centre of pressure. **(05 Marks)**

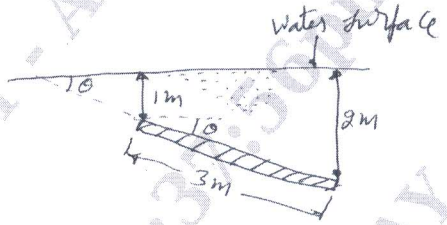

Fig. Q2 (c)

Module-2

3 a. Differentiate between following types of fluid flows: (i) Steady and unsteady flow (ii) Uniform and non uniform flow (iii) Laminar and turbulent flow. **(06 Marks)**

b. The velocity vector in a fluid flow is given $V = 4x^3i - 10x^2yj + 2tk$. Find the velocity and acceleration of a fluid particle at (2, 1, 3) at time t = 1 units. **(05 Marks)**

c. Derive a continuity equation for Cartesian coordinate of three dimensional fluid flows in its most general form. **(05 Marks)**

OR

4 a. The velocity potential function is given by an expression, $\phi = \frac{-xy^3}{3} - x^2 + \frac{x^3y}{3} + y^2$.

(i) Find the velocity components in x and y direction.

(ii) Show that ϕ represents a possible case of flow. **(05 Marks)**

b. Derive Euler's equation of motion along a stream line for an ideal fluid stating clearly the assumptions. **(06 Marks)**

c. The water is flowing through a pipe having diameters 20 cm and 10 cm at section 1 and 2 respectively. The rate of flow through pipe is 35 lit/s. 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. **(05 Marks)**

Module-3

5 a. State Buckingham's π-theorem. **(01 Marks)**

b. Explain briefly laws of similitude. **(05 Marks)**

c. Performance of a turbomachine depends on the following variables : Discharge (Q), Speed or RPM (N), size or Rotor diameter (D), Energy per unit mass flow (gH), Power (P), Density of fluid (ρ), Dynamic viscosity of fluid (μ). Using the dimensional analysis obtain the μ-numbers. **(10 Marks)**

OR

6 a. List the various flow meters and derive the relation for discharge through venturimeter. **(06 Marks)**

b. Explain the working of a pitot tube. **(04 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. Explain parts of a turbomachine with suitable figure. **(06 Marks)**

b. Compare turbomachine with positive displacement machine. **(10 Marks)**

OR

8 a. Derive an expression for Euler Turbine equation. **(08 Marks)**

b. Obtain relation between the degree of reaction and utilization factor. **(08 Marks)**

Module-5

9 a. Explain classification of hydraulic machines with an example for each class. **(08 Marks)**

b. Derive an expression for maximum hydraulic efficiency of Pelton turbine in the form,

$$\eta = \frac{1 + C_b \cot \beta_2}{2}.$$ **(08 Marks)**

OR

10 a. What is the need for compounding? List out methods of compounding. **(04 Marks)**

b. Stream flows through the nozzle with a velocity of 450 m/s at a direction which is inclined at an angle of 16° to the wheel tangent. Steam comes out of the moving blades with a velocity of 100 m/s in the direction of 110° with the direction of blade motion. The blades are equiangular and the steam flow rate is 10 kg/s. Find : (i) Power developed (ii) The power lost due to friction. (iii) Axial thrust (iv) Blade efficiency (v) Blade co-efficient. **(12 Marks)**

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