18MT42

USN

Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025
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 Newton' law of viscosity? Describe classification of fluids based on viscosity.
                                                                                                   (08 Marks)
   b. Define Capillarity. Derive an expression for capillary rise.   (06 Marks)

   c. Explain surface tension, vapour pressure and cavitations.   (06 Marks)

OR

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

   b. A simple U-tube monometers containing mercury is connected to a pipe in which a fluid of specific gravity 0.8 and having vacuum pressure is flowing. The other end of the monometers is open to the atmosphere. Find the vacuum pressure in the pipe, if the difference of mercury level in two limits is 40 cm and the height of fluid in the left from the centre of the pipe is 15 cm below.   (06 Marks)

   c. Define total pressure and centre of pressure.   (06 Marks)

Module-2

3 a. Derive continuity equation of fluid flow in three dimensional Cartesian coordinate.
                                                                                                   (08 Marks)

   b. Define stream function and velocity potential function by writing mathematical expression?
                                                                                                   (06 Marks)

   c. If for a two dimensional potential flow, the velocity potential is given by $\phi = x(2y - 1)$. Determine the velocity at a point P(4, 5). Determine also the value of stream function at the point P?   (06 Marks)

OR

4 a. Derive Bernoulli's equation of fluid motion stating assumptions made?   .   (10 Marks)

   b. The water is flowing through a taper pipe of length 100 m having diameters 600 mm at the upper and 300 mm at the lower end, at the rate of 50 litres/s. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 19.62 N/cm^2.
                                                                                                   (10 Marks)

Module-3

5 a. Define Buckingham's Pi theorem. Explain method of selecting repeating variables.
                                                                                                   (05 Marks)

   b. Explain laws of similitudes.   (15 Marks)

OR

6   a.   Derive an expression for discharge through V-notch flow measuring device? **(12 Marks)**

b.   An orifice meter with an orifice diameter 10 cm is inserted in a pipe of 20 cm diameter. The pressure gauge fitted upstream and downstream of orifice meter given readings of 19.62 N/cm^2 and 9.81 N/cm^2 respectively. Coefficient of discharge for the meter is given as 0.6. Find the discharge of water through the pipe? **(08 Marks)**

Module-4

7   a.   Define turbomachines. Explain its principle components. **(08 Marks)**

b.   Distinguish between positive displacement machines and turbomachines. **(12 Marks)**

OR

8   a.   Derive Euler's turbine equation with suitable diagrams. **(08 Marks)**
b.   Explain components of energy transfer obtaining alternate form of Euler turbine equation.
(12 Marks)

Module-5

9   a.   Derive an expression for maximum work done and maximum efficiency of pelton wheel turbine. **(10 Marks)**

b.   An inward flow reaction turbine with radial discharge with an overall efficiency of 80% is required to develop 147 kW. The head is 8m, velocity of flow is $0.36\sqrt{2gH}$. The wheel is to make 150 rpm and the hydraulic losses in the turbine are 22% of the available energy. Determine :
   i)   the angle of guide blade at inlet
   ii) The wheel vane angle at inlet
   iii) The diameter of the wheel and
   iv) The width of the wheel at inlet. **(10 Marks)**

OR

10 a.   Derive maximum blade efficiency equation $Cos^2\alpha_1$ of impulse turbine with equiangular blades. **(10 Marks)**

b.   Explain following types of turbines :
   i)   Velocity compounded impulse turbine and
   ii)   Pressure compounded impulse turbine. **(10 Marks)**

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