Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – SUMMER 2024

Subject Code:3141906 Date:18-07-2024

Subject Name: Fluid Mechanics and Hydraulics Machines

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Define the following fluid properties: 1. Dynamic viscosity 2. Specific gravity 3. Specific weight	**03**
	(b)	Justify that "Intensity of pressure at any point in a fluid at rest is same in all direction".	**04**
	(c)	Describe capillarity phenomenon. Derive an expression for capillary fall and capillary rise of a liquid.	**07**
Q.2	**(a)**	Differentiate: 1. Uniform and non-uniform flow 2. Steady and unsteady flow	**03**
	(b)	Write a difference between "absolute pressure" and "gauge pressure".	**04**
	(c)	State and explain – "Hydrostatic law" for pressure variation.	**07**
		OR	
	(c)	A thin square plate 0.3 m × 0.3 m is placed horizontally in the middle of a gap of height 2.5 cm. This gap is filled with oil of viscosity 0.2 Pa·s and the plate is pulled at constant velocity of 0.2 m/s. Find the total force on the plate.	**07**
Q.3	**(a)**	Define the terms "buoyancy" and "centre of buoyancy".	**03**
	(b)	A rectangular block of size 3 m long × 1.5 m wide × 1 m high floats in water such that it's depth of immersion is 0.8 m. What is the wight of block? Determine metacentric height and comment on outcome.	**04**
	(c)	Show that the distance between the metacentre (M) and centre of buoyancy (B) is expressed by $BM = \frac{I}{V}$.	**07**
		OR	
Q.3	**(a)**	Explain the terms rotation and vorticity.	**03**
	(b)	Obtain an expression for continuity equation for a three-dimensional flow.	**04**
	(c)	If the velocity components are given by, $u = 8 + 4xy + t^2, \quad v = -(xy + 20t), \quad w = 5x + y$ Determine velocity and acceleration of particle at (2,1,1) and t = 1 sec.	**07**
Q.4	**(a)**	State Buckingham's π-theorem. How repeating variables are selected in dimensional analysis?	**03**
	(b)	State Model (similarity) laws. Where they are used? Explain Euler's modal law.	**04**

(c) Using Buckingham's π-theorem, show that the velocity through a circular orifice is given by - **07**

$$V = \sqrt{2gH}\,\phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$$

Where, H = Head causing flow, D = Diameter of the orifice, V = flow velocity, μ = Coefficient of viscosity, ρ = Mass density and g = Acceleration due to gravity.

OR

Q.4 **(a)** Explain the advantages of Kaplan turbine over Fransis turbine **03**

(b) Classify Hydraulic turbines on the basis of various criteria. **04**

(c) A jet of water of diameter 8 cm strikes a flat plate normally with a velocity of 20 m/s. The plate is moving with a velocity 12 m/s in the direction of the jet and away from the jet. Find: the force exerted by the jet on the plate, work done by the jet on the plate per second. **07**

Q.5 **(a)** Determine the head lost due to friction in a pipe. Diameter and length of pipe is 250 mm and 60 m, respectively. Velocity of flowing water inside pipe = 2.5 m/s, Chezy's constant = 60. Use Chezy's formula, $V = C\sqrt{mi}$ **03**

(b) What is pump? How pumps are classified? **04**

(c) What is Hagen-Poiseuille's formula? Derive an expression for Hagen-Poiseuille's formula. **07**

OR

Q.5 **(a)** Explain the application and working of "Draft tube". **03**

(b) List out and explain losses in a centrifugal pump. **04**

(c) Write a note on hydraulic crane. **07**

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