Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV(NEW) EXAMINATION – WINTER 2022

Subject Code:3141906 Date:14-12-2022

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)**	State and explain the Newton's law of viscosity.	**03**
	(b)	State and prove 'Pascal's Law'.	**04**
	(c)	State and prove Bernoulli's equation. List the assumptions which are made while deriving Bernoulli's equation. What are the limitations of the Bernoulli's equation?	**07**
Q.2	**(a)**	Explain briefly the following types of equilibrium of floating bodies: i. Stable equilibrium, ii. Unstable equilibrium, and iii. Neutral equilibrium	**03**
	(b)	Derive the continuity equation in cartesian coordinates.	**04**
	(c)	A horizontal venturimeter with inlet diameter 200 mm and throat diameter 100 mm is employed to measure the flow of water. The reading of the differential manometer connected to the inlet is 180 mm of mercury. If the co-efficient of discharge is 0.98, determine the rate of flow.	**07**
		OR	
	(c)	Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid.	**07**
Q.3	**(a)**	What are repeating variables? How are these selected by dimensional analysis?	**03**
	(b)	Define and explain the following terms: i. Metacentre, and ii. Metacentric height	**04**
	(c)	Using Buckingham's π-theorem, show that the velocity through a circular orifice is given by $$V = \sqrt{2gH}\ \varphi\left[\frac{D}{H}, \frac{\mu}{\rho V H}\right]$$ Where, H = Head causing flow, D = Diameter of the orifice, μ = Co-efficient of viscosity, ρ = Mass density, and g = Acceleration due to gravity.	**07**
		OR	
Q.3	**(a)**	Obtain the equation to the streamlines for the velocity field given as: $$V = 2x^3 i - 6x^2 y j$$	**03**

(b) Show that the value of co-efficient of friction for viscous flow through a circular pipe is given by, **04**

$$f = \frac{64}{Re}$$

where *Re* = Reynolds number.

(c) Derive Hagen-Poiseuille equation and state the assumptions made. **07**

Q.4 **(a)** What is an equivalent pipe? **03**

(b) Explain briefly the following: **04**

i. Hydraulic gradient line (H.G.L.)

ii. Energy gradient line (E.G.L.)

(c) A Pelton wheel is to be designed for the following specifications: **07**

Power (brake or shaft) = 9560 kW

Head = 350 metres

Speed = 750 rpm

Overall efficiency = 85%

Jet diameter not to exceed 1/6 th of the wheel diameter

Determine the following:

(i) The wheel diameter,

(ii) Diameter of the jet, and

(iii) The number of jets required.

Take C_V = 0·985, Speed ratio = 0.45.

OR

Q.4 **(a)** Derive an expression for the force exerted by a jet of water striking on curved vane tangentially at one tip and leaving at the other end. **03**

(b) Give the comparison between impulse and reaction turbines. **04**

(c) What is governing and how it is accomplished for Fransis turbine? **07**

Q.5 **(a)** What is priming? Why is it necessary? **03**

(b) Explain with neat sketch, the working of an air lift pump. Mention its advantages. **04**

(c) A centrifugal pump is to discharge 0.118 m^3/s at a speed of 1450 rpm against a head of 25 m. The impeller diameter is 250 mm, its width at outlet is 50 mm and manometric efficiency is 75 percent. Determine the vane angle at the outer periphery of the impeller. **07**

OR

Q.5 **(a)** What is the difference between a fluid coupling and a fluid torque converter? **03**

(b) Why does a Pelton wheel not possess any draft tube? Explain. **04**

(c) Enumerate the losses which occur when a centrifugal pump operates. Explain briefly the following efficiencies of a centrifugal pump: **07**

i. Manometric efficiency,

ii. Volumetric efficiency,

iii. Mechanical efficiency, and

iv. Overall efficiency.

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