Seat No.: ________ Enrolment No. ________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– V (New) EXAMINATION – WINTER 2019

Subject Code: 2154002 **Date: 21/11/2019**

Subject Name: Fluid Mechanics and Hydraulics

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

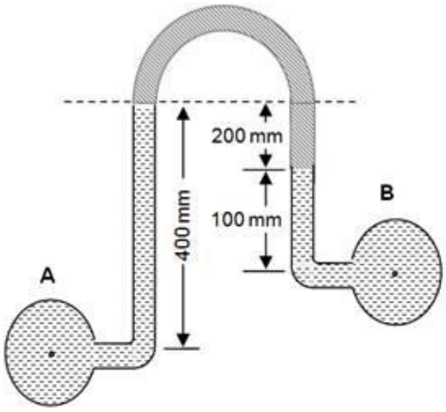
Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Explain the followings in detail: (i) Newtonian and Non-newtonian fluids; (ii) Surface Tension; (iii) Compressibility; (iv) Vapour pressure.	**07**
	(b)	Derive an expression for the depth of center of pressure from free liquid surface of an inclined plane surface submerged in the liquid.	**07**
Q.2	**(a)**	In a two-dimensional, incompressible flow the fluid velocity components are given by: u = x – 4y and v = – y – 4x. Show that the flow satisfies the continuity equation and obtain the expression for the stream function. If the flow is potential (irrotational) obtain also the expression for the velocity potential.	**07**
	(b)	State Bernoulli's theorem and derive Bernoulli's equation from fundamentals. Mention the assumptions made. List out its engineering applications.	**07**
		OR	
	(b)	What is free jet of liquid? Derive an expression for the path travelled by free jet issuing from a nozzle.	**07**
Q.3	**(a)**	What is orifice-meter? Derive an expression for the discharge through an orifice-meter.	**07**
	(b)	The following data is given for a Francis Turbine. Net head H = 60 m; Speed N = 700 rpm; shaft power = 294.3 kW; η_0 = 84%; η_h = 93%; flow ratio = 0.20; breadth ratio n = 0.1; Outer diameter of the runner = 2 × inner diameter of runner. The thickness of vanes occupy 5 % of circumferential area of the runner, velocity of flow is constant at inlet and outlet and discharge is radial at outlet. Determine: (i) Guide blade angle; (ii) Runner vane angles at inlet and outlet; (iii) Diameters of runner at inlet and outlet; and (iv) Width of wheel at inlet.	**07**
		OR	
Q.3	**(a)**	Derive an expression for the discharge over a triangular notch in terms of head of water over the crest of the notch.	**07**
	(b)	Draw and discuss the characteristics curves of a centrifugal pump.	**07**
Q.4	**(a)**	Three pipes of diameters 300 mm, 200 mm and 400 mm having lengths 450 m, 255 m and 315m respectively are connected in series. The difference in water surface levels in two tanks is 18 m. Determine the rate of flow of water if co-efficient of friction are 0.0075, 0.0078 and 0.0072 respectively, considering: (i) Minor losses and (ii) Neglecting minor losses.	**07**
	(b)	Explain briefly the following in context to open channel flow: (i) Uniform and non-uniform flows; (ii) Laminar and turbulent flows; (iii) Steady and unsteady flows; (iv) Subcritical and supercritical flows; (v) Gradually varied and rapidly varied flows.	**07**
		OR	
Q.4	**(a)**	Derive Darcy-Weisbach formula for loss of head due to friction in pipe.	**07**
	(b)	The discharge of water through a rectangular channel of width 8 m, is 15 m^3/s when depth of flow of water is 1.2 m. Calculate: (i) Specific energy of the flowing	**07**

water; (ii) Critical depth and critical velocity; (iii) Value of minimum specific energy (iv) Froude number and state whether flow is subcritical or supercritical.

Q.5	**(a)**	Determine from first principle the conditions required for the formation of hydraulic jump in the case of a rectangular channel of constant width and derive an expression for loss of head in terms of depth just before and after the hydraulic jump.	**07**
	(b)	An inverted tube differential manometer having an oil of specific gravity 0.8 is connected to two different pipes carrying water under pressure. Determine the pressure in the pipe B. The pressure in pipe A is 4 m of water.	**07**



OR

Q.5	**(a)**	The resisting force of a plane during flight can be considered as dependent upon the length of aircraft, velocity, air viscosity, air density, and bulk modulus of air. Express the fundamental relationship between these variables and the resisting force using dimensional analysis.	**07**
	(b)	Derive Hagen-Poiseuille equation and state the assumptions made.	**07**

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