Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering - SEMESTER - IV EXAMINATION - SUMMER 2025

Subject Code: 3140611 **Date: 19-05-2025**

Subject Name: Fluid Mechanics & 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.**

			Marks
Q.1	**(a)**	Define: Mass density, Specific weight and Specific gravity	**03**
	(b)	Explain different types of Equilibrium of floating body.	**04**
	(c)	Explain different types of pressure-measuring devices with neat sketches.	**07**
Q.2	**(a)**	Define the terms Buoyancy, Metacentre and Metacentric height.	**03**
	(b)	What is a hydrostatic paradox? Explain with an example.	**04**
	(c)	Derive the expression for total pressure for a vertical plate submerged in the liquid.	**07**
		OR	
	(c)	A vertical rectangular gate is 2 m wide and 4 m high. It is submerged in water with the top edge at the water surface. Find the total hydrostatic force on the gate and the position of the center of pressure.	**07**
Q.3	**(a)**	What are hydraulic coefficients of orifices? Define and explain them.	**03**
	(b)	Explain Reynolds number. Discuss its significance.	**04**
	(c)	Derive Bernoulli's equation for fluid flow and mention assumptions made.	**07**
		OR	
	(a)	What are streamlines and flow nets? Give their practical importance.	**03**
	(b)	Describe the phenomenon of water hammer and its effects.	**04**
	(c)	A horizontal venturimeter with inlet and throat diameters 40 cm and 20 cm respectively is used to measure rate of water. The reading of differential manometer connected to the venturimeter is 15 cm of mercury. Determine the rate of flow. Take coefficient of discharge equal to 0.98.	**07**
Q.4	**(a)**	Derive an expression for velocity measurement using a Pitot tube.	**03**
	(b)	Explain the concept of specific energy in open channel flow with a diagram.	**04**
	(c)	Derive Hagen-Poiseuille's equation for laminar flow in a circular pipe.	**07**
		OR	
	(a)	Draw velocity distribution in pipe flow and open channel flow.	**03**

	(b)	Discuss the significance of hydraulic gradient line (HGL) and Total energy line (TEL) in pipe flow analysis.	**04**
	(c)	Enlist the major and minor loses in pipes. Derive the Darcy-Weisbach equation for calculating head loss due to friction.	**07**
Q.5	**(a)**	Differentiate between pipe flow and open channel flow.	**03**
	(b)	Discuss geometric, kinematic, and dynamic similarity.	**04**
	(c)	Prove that the most economical trapezoidal section has a hydraulic radius equal to half the depth.	**07**

OR

	(a)	Derive the relation between critical depth and discharge for a rectangular channel.	**03**
	(b)	What is dimensional homogeneity? Why is it important?	**04**
	(c)	A trapezoidal channel section has a bed width 5.5 m laid at a bed slope of 1 in 2000. Side slope of the channel is 1H : 05V. Depth of flow in the channel is 2.00 m. Find the discharge in the channel. Take Manning's constant 0.015.	**07**

***

Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3140611 Date:03-07-2024

Subject Name:Fluid Mechanics & 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.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Define Non-Uniform flow, Supercritical Flow, RVF	**03**
	(b)	Compare flow discharge measurement by Notch and weir.	**04**
	(c)	State and explain the theorems associated with dimensional analysis.	**07**
Q.2	**(a)**	Define Venturimeter, Orificemeter, and Weir.	**03**
	(b)	What is Orifice? What are the different hydraulic coefficients associated with orifice.	**04**
	(c)	A horizontal Venturimeter with inlet diameter 25 cm and throat diameter 15 cm is used to measure the flow of oil of specific gravity 0.8. The discharge of oil through Venturimeter is 70 litres/s. Find the reading of the oil-mercury differential manometer. Take Cd as 0.97	**07**
		OR	
	(c)	The head of water over a triangular notch of angle 60^0 is 55 cm and co-efficient of discharge is 0.61. The flow measured by it is to be within an accuracy of 1.7 % up or down. Find the limiting values of the head.	**07**
Q.3	**(a)**	Define Unsteady Flow, Flow Net, Metacentric Height.	**03**
	(b)	State Bernoulli's Theorem with equation. Explain its significance.	**04**
	(c)	A solid cylinder of diameter 5 m has a height of 5 m. Find the metacentric height of the cylinder if the specific gravity of the material of cylinder is 0.6 and it is floating in the water with its axis vertical. State whether the equilibrium is stable or unstable.	**07**
		OR	
Q.3	**(a)**	Define Specific Gravity, Centre of Pressure, Viscosity.	**03**
	(b)	State and prove Pascal's law with suitable sketch.	**04**
	(c)	A U-tube manometer is used to measure the pressure of the water in a pipe line, which is in excess of the atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between the water and mercury is in the left limb. Determine the pressure of the water in the main line, if the difference in the level of mercury in the limbs of U-tube is 15 cm and the free surface of mercury is in level with the centre of the pipe.	**07**
Q.4	**(a)**	Describe the Prandtl's mixing length theory with suitable sketch,	**03**
	(b)	Derive the energy-momentum equation.	**04**
	(c)	Discuss various major and minor losses in pipes.	**07**

OR

Q.4	**(a)**	Write the continuity equation, momentum equation and Energy equation for the pipe flow.	**03**
	(b)	Derive the Hagen Poiseuille equation.	**04**
	(c)	Discuss Hardy Cross method to analyze pipe networks in series and parallel.	**07**
Q.5	**(a)**	Describe the velocity distribution in an open channel flow.	**03**
	(b)	What is Specific Energy. Derive the specific energy equation.	**04**
	(c)	Find the discharge through a trapezoidal channel of width 8 m and side slope of 1 horizontal to 3.5 vertical. The depth of flow of water is 1.9 m and the value of Chezy's constant, C=45. The slope of the bed of the channel is given 1 in 5000.	**07**

OR

Q.5	**(a)**	Discuss direct step method for GVF.	**03**
	(b)	Write down the Chezy's equation and Manning's equation along with their assumptions.	**04**
	(c)	The discharge of water through a rectangular channel of width 10 m, is 18 m^3/s when depth of flow of water is 1.4 m. Calculate: i) Specific energy of the flowing water ii) Critical depth and critical velocity iii) Value of minimum specific energy	**07**

****

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV(NEW) EXAMINATION – SUMMER 2023

Subject Code:3140611 Date:19-07-2023

Subject Name:Fluid Mechanics & 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.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	What is capillarity? Explain term cohesion and adhesion.	**03**
	(b)	A plate 0.08 mm apart from fixed plate requires stress of 2.25 N/m^2 to move at a velocity of 1.80 m/s. Determine viscosity of fluid between the plates.	**04**
	(c)	For a most economical trapezoidal channel section, show that half of top width is equals to length of one of the slopping sides.	**07**
Q.2	**(a)**	State Pascal's law and its application.	**03**
	(b)	Calculate pressure intensity at a point 4.00 m below sea water level. Take specific gravity of sea water 10 KN/m^3.	**04**
	(c)	Two pipes A and B laid at same level convey oil of specific gravity 1.35. A differential manometer connected between pipes shows difference in mercury levels as 20 cm. Find difference in pressures at the point. Take specific gravity of mercury 13.60	**07**
		OR	
	(c)	A trapezoidal channel section has a bed width 7.50 m laid at a bed slope of 1 in 3600. Side slope of the channel is 1H : 1V. Depth of flow in the channel is 2.00 m. Find the discharge in the channel. Take Manning's constant 0.015.	**07**
Q.3	**(a)**	Explain different types of Equilibrium of floating body.	**03**
	(b)	Head over the triangular 90^o V-notch is 0.40 m. Find the discharge over the notch. Take $C_d = 0.60$	**04**
	(c)	Show that stream function Ψ always satisfy continuity equation.	**07**
		OR	
Q.3	**(a)**	What is meant by hydraulic coefficient? State the relation between different hydraulic coefficients.	**03**
	(b)	A rectangular uniform wooden body 2.50 m long, 1.25 m wide and 1.00 m deep floats in water. The depth of immersion being 0.75 m. Calculate weight of the body. Also find position of metacenter.	**04**

	(c)	A pipe of diameter 127 mm conveys water. The pressure difference between two points 250 m apart is 3.25 m of water. Calculate discharge through the pipe. Take friction factor f = 0.025	**07**
Q.4	**(a)**	Describe major energy losses and minor energy losses in pipe.	**03**
	(b)	A 4.00 m wide rectangular channel conveys 30.00 m^3/s of water. Find critical depth.	**04**
	(c)	The velocity in x and y direction is given by: u = -2y and v = 2x. Check whether stream function exists or not? If so deduce it and Plot set of stream lines.	**07**
		OR	
Q.4	**(a)**	Develop relationship between maximum velocity and average velocity in case of viscous flow between two parallel plates.	**03**
	(b)	A 6.25 m wide rectangular channel conveys 18.00 m^3/s of water with a velocity of 4.50 m/s. is there a condition for hydraulic jump to occur?	**04**
	(c)	Draw a sketch of venturimeter and show its component. Develop an expression for rate of flow through venturimeter.	**07**
Q.5	**(a)**	Describe different types of fluid flow.	**03**
	(b)	What is meant by dimensional homogeneity? Write dimensions of (1) Specific weight (2) Angular velocity (3) Dynamic viscosity.	**04**
	(c)	A square plate of 2.50 m side is immersed vertically in water such that one side is parallel and lies 2.00 m below the free water surface. Calculate total hydrostatic force and center of pressure on plate.	**07**
		OR	
Q.5	**(a)**	Which flow is said to be open channel flow? Differentiate open channel flow and pipe flow.	**03**
	(b)	Explain different types of similarities between model and its prototype.	**04**
	(c)	A pipe of 20 cm diameter is conveys water at a velocity of 5.00 m/s. Find the velocity and discharge of oil flowing in another pipe of 10 cm diameter. The viscosity of oil and water is 0.03 poise and 0.01 poise resp. Take specific gravity of oil = 0.75. Assume that dynamic similarity is satisfied between two pipes.	**07**

****

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3140611 Date:04-07-2022

Subject Name:Fluid Mechanics & 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.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Define density, specific weight and specific volume.	**03**
	(b)	Calculate the specific weight, density and specific gravity of one litre of liquid which weighs 7 N.	**04**
	(c)	Write about different types of fluid in detail with example.	**07**
Q.2	**(a)**	Differentiate between Piezometer and U-tube manometer	**03**
	(b)	Prove that the rate of increase of pressure in a vertically downward direction must be equal to the specific weight of the fluid at that point.	**04**
	(c)	A differential manometer is connected at the two points A and B of two pipes as shown in Fig.1. The pipe A contains a liquid of sp.gr. = 1.5 while pipe B contains a liquid of sp.gr.= 0.9. The pressures at A and B are 1kgf/cm^2 and 1.8 kfg/cm^2 respectively. Find the difference in mercury level in the differential manometer.	**07**
		OR	
	(c)	State and Prove Pascal's Law.	**07**
Q.3	**(a)**	Define Buoyancy, Center of Pressure, and Metacentric height.	**03**
	(b)	Derive an expression for Centre of Pressure by using " Principle of Moments"	**04**
	(c)	A pipe line which is 4 m in diameter contains a gate valve. The pressure at the centre of the pipe is 19.6 N/cm^2. If the pipe is filled with oil of sp.gr. 0.87, find the force exerted by the oil upon the gate and position of centre of pressure.	**07**
		OR	
Q.3	**(a)**	Define Laminar flow, stream line and path line.	**03**
	(b)	A stream function in a two-dimensional flow is Ψ =2xy. Calculate the velocity at the point (3, 2). Find the corresponding velocity potential Φ.	**04**
	(c)	Define flow net and write in detail characteristics, applications and limitations of flow net.	**07**
Q.4	**(a)**	Explain Venturimeter and parts of Venturimeter with diagram.	**03**
	(b)	An orifice meter with orifice diameter of 150 mm is used to measure the rate of flow of oil in a pipe of 300 mm diameter. The manometer shows a pressure difference of 40 cm of mercury. Find the rate of flow of oil through pipe if sp.gr of oil is 0.8. Take coefficient of discharge for meter = 0.60	**04**
	(c)	Derive equation of velocity measurement using pitot tube. Also explain different arrangement to know the static pressure head h.	**07**
		OR	
Q.4	**(a)**	Enlist minor losses in flow through pipes.	**03**

(b) Calculate the discharge through a pipe of diameter 250 mm when the difference of pressure head between the two ends of a pipe 500 m apart is 3.5 m of water. Take value of friction factor = 0.04 **04**

(c) Derive Darcy–Weisbach equation for friction loss in the pipe. **07**

Q.5 **(a)** Define (i) Prismatic channel (ii) Gradually varied flow (iii) Wetted perimeter **03**

(b) An irrigation lined canal of trapezoidal section has to carry a discharge of 12 cumec at a longitudinal slope of 0.00048. Find the dimensions of most economical section if channel has side slope of 3 horizontal to 2 vertical. Take Manning's constant n = 0.013. **04**

(c) Derive the geometrical conditions for the most economical section of a triangular channel. **07**

OR

Q.5 **(a)** Define (i) Reynold's number (ii) Mach number (iii) Weber number **03**

(b) Write in detail about (i) Geometric similarity (ii) Kinematic similarity **04**

(c) The efficiency η of a fan depends on the density ρ, dynamic viscosity μ, the angular velocity ω, Diameter D of the rotor and the discharge Q. Express η in terms of dimensionless parameters. **07**