Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VI EXAMINATION – WINTER 2025

Subject Code:3160618 Date:25-11-2025

Subject Name:Open Channel flow

Time:02:30 PM TO 05:00 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 are the different types of channels?	**03**
	(b)	Explain the velocity distribution in open channel flow.	**04**
	(c)	Explain continuity and momentum equation for open channel flow.	**07**
Q.2	**(a)**	What is specific energy? Draw curve of it.	**03**
	(b)	Define: 1. Section modulus, 2. Alternate depths, 3. Sequent depths, 4. Flumes	**04**
	(c)	Derive differential equation of gradually varied flow with assumptions.	**07**
		OR	
	(c)	Explain surges in open channel and their types.	**07**
Q.3	**(a)**	Write on drawdown and back water curves.	**03**
	(b)	What is hydraulic jump? Explain applications of it.	**04**
	(c)	Explain classification of flow profiles with examples.	**07**
		OR	
Q.3	**(a)**	Calculate the critical depth and the corresponding specific energy for a discharge of 5 m^3/s in the rectangular channel of width 2.0 m.	**03**
	(b)	What is energy dissipation? Define location of hydraulic jump.	**04**
	(c)	Explain and derive St. Venant's equation.	**07**
Q.4	**(a)**	Define gradually varied and rapidly varied flow.	**03**
	(b)	What is unsteady flow? What are the types?	**04**
	(c)	In a rectangular channel 3.5 m wide laid at a slope of 0.0036, uniform flow occurs at a depth of 2.0 m. Find how high the hump be raised without causing afflux?	**07**
		OR	
Q.4	**(a)**	A concrete lined trapezoidal channel (n=0.015) is to have a side slope of 1:1. The bottom slope is 0.0004. Find the bottom width of the channel necessary to carry 100 m^3/s of discharge at normal depth of 2.5 m.	**03**
	(b)	What do you mean by non-scouring channels?	**04**
	(c)	Explain regimes of flow & prediction of regimes.	**07**
Q.5	**(a)**	What is Incipient motion?	**03**
	(b)	What are the types of bed forms? What is the difference between aggradation and degradation?	**04**
	(c)	A circular drainage pipe 0.80 m in diameter conveys a discharge at a depth of 0.30 m. If the pipe laid on the slope of 1 in 900, estimate the discharge. Manning's n=0.015.	**07**
		OR	
Q.5	**(a)**	Explain in brief Lacey's regime theory.	**03**
	(b)	A hydraulic jump takes place in a rectangular channel with sequent depths of 0.25 m and 1.5 m at the beginning and end of the jump respectively. Estimate the i) discharge per unit width of the channel and ii) energy loss.	**04**
	(c)	Write in brief about shield's analysis. Write in brief about flow resistance.	**07**

Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VI (NEW) EXAMINATION – WINTER 2024

Subject Code:3160618 Date:05-12-2024

Subject Name:Open Channel flow

Time:02:30 PM TO 05:00 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)**	Show that for a very wide rectangular channel the hydraulic radius is equal to the depth of flow in the channel.	**03**
	(b)	Draw definition sketch to derive the equilibrium equation: $\tau = w\,RS_0$ for uniform steady flow.	**04**
	(c)	Discuss the practical utility and application of hydraulic jump.	**07**
Q.2	**(a)**	Draw a definition sketch to show hydraulic grade line and energy line to show the difference between pipe flow and open channel flow.	**03**
	(b)	Show that for a rectangular channel the critical depth $y_c = (\frac{q^2}{g})^{0.333}$. The terms have usual meaning.	**04**
	(c)	Water flows in a rectangular channel 1 meter wide with 0.1 meter depth of flow, average velocity 1.5 meter/s and viscosity 10^{-6} meter square per second, find the state of flow.	**07**
		OR	
	(c)	For a constant specific energy 2.4 joules per newton calculate the maximum discharge that may occur in a rectangular channel 4 meter wide.	**07**
Q.3	**(a)**	Explain Froude number as a ratio of flow velocity to celerity so give reasons why ripples do not travel upstream in a supercritical flow.	**03**
	(b)	State the assumptions made in the derivation of dynamic equation of gradually varied flow profile.	**04**
	(c)	Describe the Shields curve and discuss its salient features.	**07**
		OR	
Q.3	**(a)**	For an open channel steady gradually varied flow draw a control volume show the forces acting on this control volume to apply the momentum equation across the two sections.	**03**
	(b)	Use Manning's equation to explain the terms normal flow and normal discharge for a uniform flow.	**04**
	(c)	Cite the practical situations in which M_1 and M_2 type of profiles occur and explain their characteristics using the dynamic equation of the gradually varied flow.	**07**
Q.4	**(a)**	Give the physical interpretation and importance of hydraulic radius.	**03**

	(b)	Explain the term section factor for a uniform flow.	**04**
	(c)	In a wide rectangular channel other factors remaining constant if the normal depth is increased by 20% find the increase in discharge using Chezy's equation.	**07**

OR

Q.4	**(a)**	Explain grain shear stress and form shear stress for a mobile boundary channel.	**03**
	(b)	Explain hydrostatic pressure for channels of large slope and channels of small slope.	**04**
	(c)	Explain in detail channels of the first and the second kind	**07**
Q.5	**(a)**	Use Chezy's equation to explain conveyance of flow in a uniform steady open channel flow.	**03**
	(b)	Draw hydrostatic pressure diagram for a surface concave upwards and having a normal acceleration "a_n"	**04**
	(c)	A sewer pipe is proposed to be laid on a slope of 1 in 3000 and is required to carry a discharge of 2 cumec. What size of the pipe should be used if you plan it to flow half full? Take Manning's n = 0.014.	**07**

OR

Q.5	**(a)**	Give the reasons why positive surges have a stable profile and preserved shape while negative surge have an unstable profile.	**03**
	(b)	Draw the definition sketch giving causes of occurrence for (i) positive surge moving upstream and a positive surge moving downstream (ii) negative surge moving upstream and negative surge moving downstream.	**04**
	(c)	Use specific energy diagram to explain the variation of upstream and downstream depth of flow for a rectangular channel due to provision of hump (i) when approaching depth is sub critical (ii) when approaching depth is supercritical	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – WINTER 2023

Subject Code:3160618 Date:13-12-2023

Subject Name: Open Channel flow

Time:02:30 PM TO 05:00 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.**

Q.1	**(a)**	Classify the flows in channel.	**03**
	(b)	Derive the expressions for critical depth in channels of circular sections.	**04**
	(c)	Draw definition sketch for energy equation.	**07**
Q.2	**(a)**	Explain the subcritical flow in channel with sketch.	**03**
	(b)	Obtain the value of first hydraulic exponent (M) for the rectangular and triangular channels.	**04**
	(c)	Show that in triangular channel the froude number corresponding to alternate depth are given by $F1/F2 = (4+F_2^2)^{5/2} / (4+ F_2^2)^{5/2}$	**07**
		OR	
	(c)	Find the critical depth for a specific energy head of 1.5 m in the following channels: (a) Rectangular channel, B = 2.0 m, (b) Triangular channel , B = 1.5 m (c) Trapezoidal channel, B = 2.0 m and m = 1.0 m	**07**
Q.3	**(a)**	Define (1) Critical depth (2) Section factor (3) Froude Number	**03**
	(b)	Which are the factors affecting on ‘n’- Mannings coefficient?	**04**
	(c)	Explain velocity distribution for turbulant flow in channel.	**07**
		OR	
Q.3	**(a)**	Explain in detail ‘S’ type flow profile.	**03**
	(b)	Write short note on ‘Transitional Depth’.	**04**
	(c)	What is the role of end condition in the open flow channel?	**07**
Q.4	**(a)**	Which are the different simple numerical solutions of GVF problem.	**03**

	(b)	Describe the classifications of hydraulic jump.	**04**
	(c)	Short note on: Standing wave Flume.	**07**

OR

Q.4	**(a)**	Explain in brief Lacey's regime theory.	**03**
	(b)	Explain concept of shield's analysis for uniform flow in mobile Boundary channels.	**04**
	(c)	Derive the equation for energy loss in hydraulic jump.	**07**
Q.5	**(a)**	What are the limitations of Kennedy's theory?	**03**
	(b)	Discuss positive surge and negative surge.	**04**
	(c)	Derive the equation of motion for Gradually Varied Unsteady Flow (GVUF) in a prismatic channel.	**07**

OR

Q.5	**(a)**	Define spatically varied flow	**03**
	(b)	Describe the characteristics of flow over spillway.	**04**
	(c)	A standard lined trapezoidal canal section is to be designed to convey 100 m^3/s of flow. The side slopes are to be 1.5 horizontal: 1 vertical and Manning's n = 0.016. The longitudinal slope of the bed is 1 in 5000. If a bed width of 10.0 m is preferred what would be the normal depth?	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3160618 Date:17-12-2022

Subject Name:Open Channel flow

Time:02:30 PM TO 05:00 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)**	Explain the term 'Specific energy in fluid flow'.	**03**
	(b)	Explain with example the velocity distribution in open channel.	**04**
	(c)	Derive the expressions for the critical depth in channels of various geometric shapes.	**07**
Q.2	**(a)**	Explain the term 'First Hydraulic Exponent (M)'.	**03**
	(b)	Derive the basic equation of continuity for steady and unsteady open channel flow.	**04**
	(c)	Write a note on compound channel sections.	**07**
		OR	
	(c)	Explain incipient motion condition for sediment particles.	**07**
Q.3	**(a)**	Write a note on Manning's roughness coefficient.	**03**
	(b)	Discuss the types of uniform flow computation problems.	**04**
	(c)	Explain the concept of shield's analysis for uniform flow.	**07**
		OR	
Q.3	**(a)**	Write a note on prediction of flow regimes.	**03**
	(b)	Derive the equations of hydraulic mean depth for triangular and trapezoidal channel sections of rigid boundary channels.	**04**
	(c)	Explain the concept of equivalent roughness of a channel.	**07**
Q.4	**(a)**	Discuss the characteristics of jump in a rectangular channel.	**03**
	(b)	Discuss the permissible velocities in rigid boundary channels.	**04**
	(c)	Give the classification of flow profiles based on channel category and region of flow.	**07**
		OR	
Q.4	**(a)**	What is gradually varied flow? What are the basic assumptions involved in analysis of GVF?	**03**
	(b)	Explain the features of type M and type S profiles.	**04**
	(c)	Design a concrete lined channel to carry a discharge of 300 cumecs at a slope of 1 in 6500. The side slopes of the channel may be taken as 1.5:1. The value of n for lining material may be taken as 0.013. Assume limiting depth of the channel as 4.0 m.	**07**
Q.5	**(a)**	Write a note on location of hydraulic jump.	**03**
	(b)	Explain: Undular jump, weak jump, oscillating jump, steady jump.	**04**
	(c)	Derive expression for the discharge over circular and trapezoidal sharp-crested weir.	**07**
		OR	
Q.5	**(a)**	Enlist various numerical methods for solving St. Venant equation.	**03**
	(b)	Explain (1) sluice gate (2) Standing wave flume.	**04**

(c) Derive the equation of motion for GVUF in a prismatic channel. **07**

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