Seat No./Enrollment No.: _____

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 6 – EXAMINATION – SUMMER 2026

Subject Code: 3160618 **Date: 01/06/2026**

Subject Name: Open Channel flow

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.**

Q.1	**(a)**	Define open channel flow and differentiate between an open channel and a pipe flow.	**03**
	(b)	Define specific energy in an open channel and write its mathematical expression in terms of depth of flow and velocity head.	**04**
	(c)	Describe the typical velocity distribution patterns in various channel sections and explain the factors that influence the velocity coefficients in these channels.	**07**
Q.2	**(a)**	List the various types of open channels based on their boundary materials and cross-sectional shape.	**03**
	(b)	Define 'specific force' in open channel flow and mention its primary application in analysing channel transitions.	**04**
	(c)	A trapezoidal channel has a bottom width of 5 m, side slopes of 1.5H:1V, and a bed slope of 0.0008. If the discharge is 15 m^3/s, determine the normal depth of flow using the Manning's equation by an iterative method.	**07**
		OR	
Q.2	**(c)**	An alluvial channel is to be designed for a discharge of 12 m^3/s using Shield's approach for incipient motion. If the sediment size is 5 mm, estimate the required width and depth of the channel to ensure a non-scouring design.	**07**
Q.3	**(a)**	For a trapezoidal channel with a bottom width of 3 m and side slopes of 2H:1V, calculate the wetted perimeter and area when the water depth is 1.2 m.	**03**
	(b)	Given a flow velocity of 0.8 m/s and a hydraulic radius of 0.5 m in a sandy bed channel, calculate the shear velocity and discuss its importance in predicting incipient motion.	**04**
	(c)	Analyze the design criteria for a 'most economical' rectangular channel versus a trapezoidal channel. Justify why the trapezoidal section is frequently preferred in large-scale canal projects.	**07**
		OR	
Q.3	**(a)**	Discuss how the choice of channel cross-section influences the ease of maintenance and the risk of sediment deposition in an irrigation canal system.	**03**
	(b)	Analyze the classification system of GVF profiles.	**04**
	(c)	Critically judge the design of a hydraulic structure by analyzing its impact on the GVF profile.	**07**
Q.4	**(a)**	Analyze the relationship between the channel bed slope and the stability of an alluvial channel.	**03**

(b) Critically evaluate the assumptions made in the derivation of the gradually varied flow (GVF) equation. **04**

(c) Critically examine the impact of channel slope and boundary roughness on the evolution of GVF profiles. How would an abrupt change in channel slope from mild to steep create a transition profile? **07**

OR

Q.4 **(a)** Critique the use of the 'Manning's equation' for non-uniform, gradually varied flow profiles. **03**

(b) Critique the use of hydraulic jumps in natural channel systems versus artificial concrete-lined channels. **04**

(c) Evaluate the performance of different types of hydraulic jumps. Based on energy dissipation requirements, justify which type of jump is most suitable for a spillway energy dissipater and why. **07**

Q.5 **(a)** Design a conceptual layout for a stilling basin that uses a hydraulic jump to protect an erodible downstream bed. **03**

(b) Outline a step-by-step design procedure for a hydraulic jump on a sloping rectangular channel, ensuring the jump remains contained within the apron's structural limits. **04**

(c) A spillway is designed to discharge 40 m^3/s per meter width. **07**

1. Calculate the depth of flow at the toe of the spillway, assuming a total energy head of 6 m above the crest.
2. If the tailwater depth is 4.5 m, evaluate whether a hydraulic jump will form on the spillway apron.

OR

Q.5 **(a)** What is meant by the 'celerity' of a small gravity wave, and what primary factors determine its speed? **03**

(b) List and briefly explain four common reasons why unsteady flow might develop in a controlled irrigation canal system. **04**

(c) A spillway discharges water into a rectangular channel at a velocity of 12 m/s with a flow depth of 0.6 m. **07**

1. Calculate the Froude number and determine the type of jump.
2. Calculate the required sequent depth and the total energy loss in the jump.

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