

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 4 – EXAMINATION – SUMMER 2026

Subject Code: 3140611

Date: 30/05/2026

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.

- Q.1**
- (a) Define specific weight, specific gravity and specific volume with units. 03
 - (b) State and explain Newton's law of viscosity. 04
 - (c) Derive the expression for total pressure and center of pressure on an inclined plane surface submerged in fluid. 07

- Q.2**
- (a) Sketch a U-tube manometer and derive an equation for pressure difference between two points using the manometer column heights. 03
 - (b) Derive continuity equation for a one-dimensional flow. 04
 - (c) Describe manometers and compare U-tube differential and inverted U-tube differential manometers. 07

OR

- Q.2**
- (c) A Venturimeter fitted to a horizontal pipe has an inlet diameter of 200 mm and a throat diameter of 100 mm. 07
The differential U-tube manometer shows a mercury reading of 0.18 m.
Calculate the discharge if the coefficient of discharge (C_d) is 0.98.
(Take $\rho_{\text{water}} = 1000 \text{ kg/m}^3$, $\rho_{\text{Hg}} = 13,600 \text{ kg/m}^3$).

- Q.3**
- (a) What is metacentric height? State its importance for stability of floating bodies. 03
 - (b) A U-tube manometer contains mercury ($\rho = 13,600 \text{ kg/m}^3$). The difference in levels is 0.25 m. Determine the pressure difference in kPa 04
 - (c) Explain Venturimeter with neat sketch. Derive discharge formula and give practical applications. 07

OR

- Q.3**
- (a) Distinguish between steady and unsteady flow with examples. 03
 - (b) A rectangular channel carries water of depth 2 m and discharge $6 \text{ m}^3/\text{s}$. Determine the velocity, Froude number and comment on the flow regime. (Take $g = 9.81 \text{ m/s}^2$). 04
 - (c) Derive Bernoulli's equation (energy form) and state assumptions. 07

- Q.4**
- (a) What is a hydraulic jump? State two uses in hydraulic engineering. 03
 - (b) Differentiate between major and minor losses in pipe flow with examples 04
 - (c) Describe Reynolds experiment With neat sketches and explain flow regimes. 07

OR

- Q.4**
- (a) Define Froude number and state its significance in open channel flow. 03
 - (b) Explain velocity distribution in open channel flow and factors affecting it. 04

- (c) Explain Prandtl's mixing length theory and characteristics of turbulent flow in pipes. **07**
- Q.5** (a) Water flows through a 200 m long, 200 mm diameter pipe at velocity of 3 m/s. If friction factor $f = 0.02$, compute the head loss. ($\rho = 1000 \text{ kg/m}^3$) **03**
- (b) List Buckingham Pi-theorem steps. **04**
- (c) Derive energy equation for open channel flow and explain specific energy diagram. **07**
- OR
- Q.5** (a) Write a short note on hydraulic gradient line and total energy line. **03**
- (b) Write a note on Hagen-Poiseuille equation & its limitations. **04**
- (c) Explain model similitude & describe geometric, kinematic, and dynamic similarities with examples. **07**
