Seat No./Enrollment No.: _____

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

Subject Code: BE04005031 **Date: 16/06/2026**

Subject Name: Fluid Flow Operation

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)** Discuss the effect of surface roughness on fluid flow through pipes. **03**

(b) Write down the simplified pressure drop equation for a fully fluidized bed. Explain why the pressure drop remains constant even if the velocity is increased beyond (u_{mf}). **04**

(c) Water is flowing through a 45 mm internal diameter pipe at the rate of 1 kg/s. Calculate the pressure drop over a length of 500 meters. **07**

Data : Friction factor 'f ' = 0.0002, Density of water = 1000 kg/m^3, Viscosity of water = 8.0×10^{-4} Pa . s.

Q.2 **(a)** Briefly describe the flow of fluid in boundary layers. **03**

(b) Describe the classic Reynolds Experiment with a neat schematic diagram. Explain how it distinguishes between laminar, transition, and turbulent flow regimes based on critical Reynolds numbers for a pipe flow. **04**

(c) A Venturi meter is installed in a pipe line for the measurement of flow rate of water. The pressure drop across the throat and upstream of the meter is 15 centimeters of mercury. Calculate the volumetric flow rate of water in m^3/s. **07**

Data:- Diameter of throat = 25 mm, Diameter of pipe = 35 mm, Coefficient of meter = 0.94, Density of water = 1000 kg/m^3 ,Density of mercury = 13600 kg/m^3

OR

Q.2 **(c)** Acetic acid is to be pumped through a horizontal pipeline at a steady rate. Given the operational parameters and fluid properties below, determine the total pressure drop experienced over the specified length of the pipeline. **07**

Volumetric Flow Rate (Q)	0.03 m^3/s
Pipe Internal Diameter (D)	85 mm (0.085 m)
Pipeline Length (L)	60 m
Density of Acetic Acid (ρ)	1100 kg/m^3
Viscosity of Acetic Acid (μ)	0.0075 (N·s)/m^2

Q.3 **(a)** Describe the rheological behavior of Newtonian and non-Newtonian fluids. **03**

(b) Explain asterisk condition and stagnation condition. Derive the expression for Stagnation temperature. **04**

(c) In an air pipeline, the flow has following conditions at station 1 : Temperature = 300 K , pressure = 2.8 bar, velocity = 16 m/s and pipe inside the diameter = 60 mm. The conditions at station 2 are : Temperature = 300 K , pressure = 2.3 bar and pipe inside the diameter = 85 mm. Density of air at 300 K and 2.8 bar pressure is 4.1 kg/m^3. Estimate the mass flow rate of air and the velocity at station 2. **07**

OR

Q.3 **(a)** Distinguish between notch and weir. **03**

(b) Discuss in brief about assembly used for prevention of leakages around moving parts of machine. **04**

(c) Estimate the size of a pipe required to convey 35 l/s of an oil to a distance of 3 km with a frictional head loss of 42 m. **07**

Data : Kinematic viscosity of oil is 10^{-2} m^2/s.

Q.4 **(a)** What are the advantages of Centrifugal pump over Reciprocating pump? **03**

(b) Differentiate: Variable head meter and variable area meter. **04**

(c) A rotameter has a 10 cm tube with bottom ID of 20 mm and top ID of 25 mm. The float has a volume of 5 cm^3 and density of 4500 kg/m^3. Calculate the flow rate of water (ρ = 1000 kg/m^3) when the float is at the midpoint. **07**

OR

Q.4 **(a)** What do you mean by subsonic, sonic and supersonic flows. **03**

(b) Explain in brief about isentropic flow of compressible fluid through nozzle. **04**

(c) A V-element meter is installed in a 100 mm ID pipe. Calculate the volumetric flow rate given the following parameters: **07**

Pipe Diameter (D)	100 mm (0.1 m)
Beta Ratio (β)	0.65
Differential Pressure (ΔP)	12,000 Pa (12 kPa)
Gas Density (ρ)	0.75 kg/m^3
Discharge Coefficient (Cd)	0.82
Expansion Factor (Y)	0.98

Q.5 **(a)** Discuss Suction lift in centrifugal pumps **03**

(b) Explain any one method of dimensional analysis giving an example **04**

(c) A mild steel pipeline of 300 mm inside diameter is to be installed for transporting 20 kg/s of molasses. The pipeline is 3000 m long and the delivery end is to be 8 m higher than the intake. Calculate the power requirement for the pump if the efficiency of the pump is 70%. **07**

Data : Density of molasses = 1600 kg/m^3 and μ of molasses = 0.5 Pa.s

OR

Q.5 **(a)** Explain Drag and drag coefficient. **03**

(b) Discuss in brief continuous gravity decanter. **04**

(c) A liquid of density 1500 kg/m^3 is flowing from point A to point B which is 10 meters above the point A. The frictional losses in a pipeline of internal diameter 60 mm are 2 J/kg for a volumetric flow rate of 800 cm^3/s. If points A and B are at the atmospheric pressure and the velocity at the point A is zero, calculate the pump work done. **07**

*****