Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–IV (NEW) EXAMINATION – WINTER 2023**

**Subject Code:3140611 Date:24-01-2024**

**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.**

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|---|---|---|---|
| **Q.1** | **(a)** | Define: Fluid statics, Fluid Kinematics, Kinematic viscosity | **03** |
| | **(b)** | State the Newton's law of viscosity. | **04** |
| | **(c)** | State and derive Pascal's law. | **07** |
| **Q.2** | **(a)** | Define the terms metacentre, metacentric height and absolute pressure. | **03** |
| | **(b)** | Explain equilibrium in floating bodies. | **04** |
| | **(c)** | Derive the expression for total pressure for a vertical plate submerged in the liquid. | **07** |
| | | **OR** | |
| | **(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.3** | **(a)** | Define coefficient of contraction, coefficient of velocity and coefficient of discharge for the orifice. | **03** |
| | **(b)** | Give classification of Orifices. Give the difference between an orifice and a mouthpiece. | **04** |
| | **(c)** | A pipe of diameter 100 mm conveys water. The pressure difference between two points 50 m apart is 0.6 m of water. Calculate discharge through the pipe. Take friction factor f = 0.025. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Which are the assumptions made in Bernoulli's theorem ? | **03** |
| | **(b)** | What are the advantages of triangular notch over a rectangular notch? | **04** |
| | **(c)** | A horizontal venturimeter with inlet and throat diameters 30 cm and 15 cm respectively is used to measure rate of water. The reading of differential manometer connected to the venturimeter is 20 cm of mercury. Determine the rate of flow. Take coefficient of discharge equal to 0.98 | **07** |
| **Q.4** | **(a)** | Draw velocity distribution in pipe flow and open channel flow. | **03** |
| | **(b)** | Explain Prandtl's mixing length theory. | **04** |
| | **(c)** | State Bernoulli's theorem for steady flow of an incompressible fluid. Derive Bernoulli's expression | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | Define: (i) Total energy line (ii) Hydraulic gradient line | **03** |
| | **(b)** | Explain with diagram the Specific Energy Curve. | **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)** Derive the Hagen-Poiseuille equation for laminar flow in the circular pipe. **04**

**(c)** Fluid of density ρ and viscosity μ flows at an average velocity V through a circular pipe diameter d. show by dimensional analysis that the shear stress of the pipe wall. **07**

$$\tau_o = \rho V^2 f\left[\frac{\rho V d}{\mu}\right]$$

**OR**

**Q.5** **(a)** How repeating variables are selected in the dimensional analysis. **03**

**(b)** Discuss briefly various similarities between the model and the prototype. **04**

**(c)** Explain the Buckingham's π-theorem in dimensional analysis **07**

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