

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER– IV(NEW) EXAMINATION – SUMMER 2023****Subject Code:2141906****Date:13-07-2023****Subject Name:Fluid Mechanics****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)** Find surface tension at air-water interface, if the pressure difference between the inside and outside of the air bubble of diameter 0.01 mm is 29.2 kPa. Also express equation of stagnation pressure in Compressible flow by neglecting correction factor. **07**
- (b)** Correlate discharge Q of a centrifugal pump with fluid density ρ , speed of the pump N , diameter of impeller D , manometric head H and viscosity of fluid μ by using dimensional analysis method. **07**

$$Q = ND^3 \phi \left(\frac{gH}{N^2 D^2}, \frac{\mu}{\rho N D^2} \right)$$

- Q.2 (a)** Determine equation of total pressure and center of pressure for inclined immersed surface. **07**

- (b)** Estimate head losses in sudden enlargement, **07**

$$h_e = \frac{(V_1 - V_2)^2}{2g}$$

OR

- (b)** Determine : **07**

$$Q_{act} = C_d \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \sqrt{2gh}$$

- Q.3 (a)** Determine the equation of loss of head (Darcy equation) due to friction in pipe flow. **07**

- (b)** Define Pascal's law and give outline with neat sketch about bourdon tube pressure gauge. **07**

OR

- Q.3 (a)** The velocity component in a fluid flow are given by : **07**

$$u = 2xy ; v = a^2 + x^2 - y^2$$

- i) Assess the possibility of flow
- ii) Write relative stream function for it.

- (b)** Solve Euler's equation for motion by considering steady flow of an ideal fluid along the stream tube. **07**

- Q.4 (a)** Explain pitot tube with neat sketch. **07**

- (b)** Solve equation Hagen-Poiseuille Law of pressure difference in circular pipe having viscous fluid inside. **07**

OR

- Q.4 (a)** List out methods of measuring viscosity and explain falling sphere method in detail with neat sketch. **07**

- (b)** A lubricating oil of viscosity 1 poise and specific gravity 0.9 is pumped through a 30 mm diameter pipe if the pressure drop per meter length of pipe 20 kN/m², determine: **07**

- i) The mass flow rate in kg/min,

- ii) Shear stress at the pipe wall
- iii) Reynolds number of flow and
- iv) Power required per 50 m length of the pipe to maintain the flow.

Q.5 (a) Compare the followings: 07

- i) Steady and Unsteady flow,
- ii) Uniform and Non-Uniform flow,
- iii) Rotational and Irrotational flow

(b) An isosceles triangular plate of base 3 m and altitude 3 m is immersed vertically in oil of specific gravity 0.8. The base of the plate coincides with free surface of oil. Determine total pressure on the plate and center of pressure. 07

OR

Q.5 (a) A metal plate 1.25 m x 1.25 m x 6 mm thick and weighing 90 N is placed midway in 24 mm gap between two vertical plane surfaces. The gap is filled with oil of 0.85 specific gravity and 3 N-s/m² dynamic viscosity. Determine the force required to lift the plate with a constant velocity of 0.15 m/s. 07

(b) Give the statement of Archimedes Principal and find the position of block at mercury water interface for a metallic cube 30 cm side and 450 N weight is lowered into tank containing water and mercury when it reaches equilibrium. 07
