

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-IV (NEW) EXAMINATION – WINTER 2023****Subject Code:2141906****Date:19-01-2024****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) State Newton's law of viscosity and give example of its application. **03**
 (b) What is manometer? How are they classified? **04**
 (c) Derive an expression for the force exerted on a sub-merged vertical plane surface by the static liquid and locate the position of Centre of pressure. **07**

- Q.2** (a) Explain the term meta-centre and meta-centric height. **03**
 (b) A differential manometer is connected at the two points A and B as shown in figure-1. At B air pressure is 9.81 N/cm². Find the absolute pressure at A **04**
 (c) Explain uniform flow with source and sink. Obtain expressions for stream and velocity potential functions. **07**

OR

- (c) The velocity components in a fluid flow are given by: $u=2xy$; $v=a^2+x^2-y^2$ **07**
 (1) show that the flow is possible (2) Derive the relative stream function.

- Q.3** (a) What is pitot tube? How will you determine the velocity at any point with the help of pitot tube? **03**
 (b) Define the terms: Viscosity, kinematic viscosity, velocity gradient and pressure gradient. **04**
 (c) What is venturimeter? Derive expression for the discharge through the venturimeter. **07**

OR

- Q.3** (a) Explain the term coefficient of friction. On what factors does this coefficient depend? **03**
 (b) In a pipe of 300 mm diameter and 800 m length an oil of specific gravity 0.8 is flowing at the rate of 0.45 m³/s. Find: (1) Head loss due to friction and (2) power required to maintain the flow. Take kinematic viscosity of oil as 0.3 stoke. **04**
 (c) Prove that the velocity through nozzle is given by **07**

$$v = \sqrt{\frac{2gH}{1 + \frac{4fL}{D} \times \frac{a^2}{A^2}}}, \text{ where } a = \text{Area of nozzle at outlet, } A = \text{Area of the pipe}$$

- Q.4** (a) Define Mach Number. What is the significance of Mach number in compressible fluid flow? **03**
 (b) Define the terms: model, prototype, model analysis and hydraulic similitude. **04**
 (c) A block of wood of specific gravity 0.7 floats in water. Determine the meta-centric height of the block if its size is 2 m x 1 m x 0.8 m. (Figure-2) **07**

OR

- Q.4** (a) Explain hydrostatic paradox with suitable example. **03**
 (b) What is capillarity? Derive expression for Capillary rise $h = \frac{4\sigma}{\rho g d}$ **04**
 (c) A pipeline carrying oil (specific gravity 0.8) changes in diameter from 300 mm at position 1 to 600 mm diameter at position 2 which is 5 metres at a higher level. If the **07**

pressures at positions 1 and 2 are 100 kN/m^2 and 60 kN/m^2 respectively and the discharge is 300 litres/sec . Determine (1) loss of head (2) direction of flow

- Q.5 (a)** Define stagnation pressure, stagnation temperature and stagnation enthalpy. **03**
(b) A rectangular notch 0.5 m long is used for measuring a discharge of $0.04 \text{ m}^3/\text{s}$. An error of 2 mm was made in measuring the head over the notch. Calculate the percentage error in the discharge. Take $C_d=0.6$ **04**
(c) State and prove the Pascal's law. **07**

OR

- Q.5 (a)** Define following terms: (1) steady flow (2) non-uniform flow (3) Laminar flow **03**
(b) What are the conditions of equilibrium of a floating and a sub-merged body? **04**
(c) Derive Bernoulli's equation for the flow of an incompressible frictionless fluid from consideration of momentum. **07**

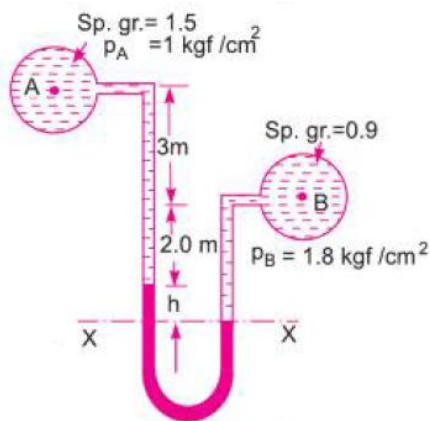


Figure-1

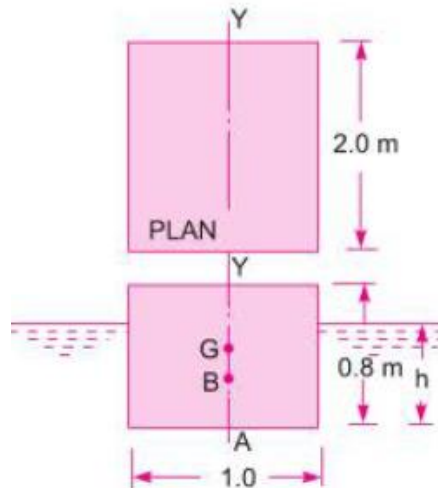


Figure-2
