SECOND YEAR SECOND SEMESTER EXAMINATIONS
FOR
BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL ENGINEERING

COURSE CODE: **CSE 252**
COURSE NAME: **FLUID MECHANICS**

Instructions to candidates

- This paper consists of **FIVE (5)** questions
- Answer **QUESTION ONE** and **ANY OTHER THREE (3)** questions
- All symbols have their usual meanings unless otherwise stated
- Time allowed is **THREE (3)** hours

Question ONE {Compulsory (40 marks)}

a) Define the following fluid properties
   i. Mass Density (1 mark)
   ii. Specific volume (1 mark)
   iii. Specific gravity (1 mark)

b) Water flows over rectangular notch of 1m length over a depth of 150mm. The same quantity of water is made to pass through a triangular right-angled notch. Find the depth of water through the second notch. Take coefficients of discharge for the 1st and 2nd notches as 0.62 and 0.59 respectively (6 marks)

c) A block of wood of size 100×40×30mm and specific gravity 0.8 floats in water as shown in Figure Q1 (c). Determine its metacentric height for tilt about its longitudinal axis, and state whether it is in stable equilibrium. (8 marks)

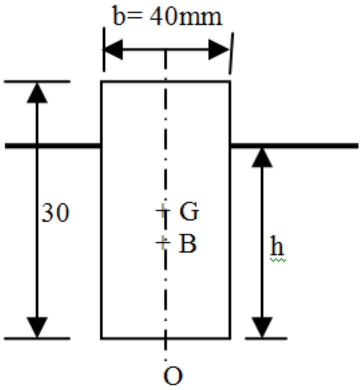

Figure Q1 (c)

d) A tank has two similar orifices in one of its vertical sides. The upper orifice is situated 3m below the water surface and the lower one is 5m below the water surface. If the value of *Cv* for both orifices is 0.97, find the horizontal distance of the point from the orifices where the two jets intersect (8 marks)

e) Each gate of a 5m wide lock is 6m high and is supported by two hinges placed on top and bottom of the gate as shown in Figure Q1 (e). When the gates are closed, they make an angle of 1200. If the water levels are 4m and 2m on the upstream and downstream sides respectively, determine the magnitudes of the forces on the hinges due to water pressure. (15 marks)

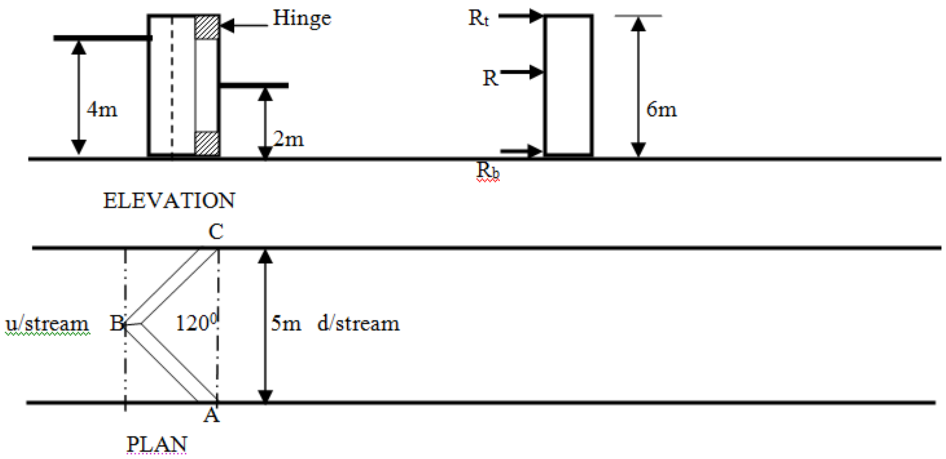

Figure Q1 (e)

Question TWO (20 marks)

a) What are the advantages and disadvantages of using manometers for pressure measurements? (4 marks)

b) Determine the specific weight, mass density, specific volume and specific gravity of 2 litres of a liquid which weighs 7N. (6 marks)

c) Find out the differential reading 'h' of insversted U-tube manometer containing oil of specific gravity of 0.7 as manometric fluid when connected across pipes A and B as shown in Figure Q2 (c) below, conveying liquids of specific gravities of 1.2 and 1.0 respectively. Pipes A and B are located at the same level and assume that pressures at A and B are equal (10 marks)

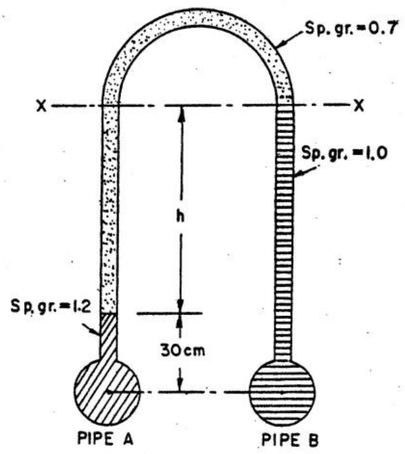

Figure Q2 (c)

Question THREE (20 marks)

a) Determine the magnitude and direction of the resultant water pressure acting on a curved face of a dam which is shaped according to the relationship $y = \frac{x^2}{4}$, as shown in (Figure Q3 (c). Take the width of dam as unity. (6 marks)

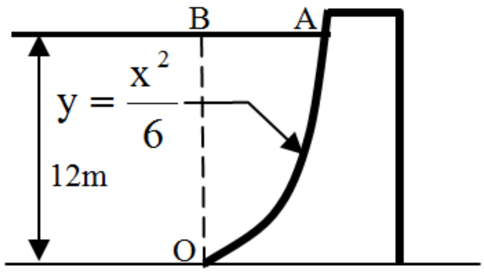

Figure Q3 (a)

b) Using Buckingham's π theorem, show that the velocity through a circular orifice is given by

$$V = \sqrt{2gH}\,\emptyset\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$$

Where H is the head causing flow, D is the diameter of the orifice, μ is the co-efficient of viscosity, ρ is the mass density and g is the acceleration due to gravity (14 marks)

Question FOUR (20 marks)

a) Define the terms
   i. buoyancy and (2 marks)
   ii. centre of buoyancy (2 marks)

b) A plate which is 0.025m from a fixed plate moves at 60 cm/s and requires a force of 3 N/m^2 to maintain this speed. Determine the fluid viscosity between the plates (4 marks)

c) State Bernoulli's equation and show that

$$\frac{P}{w} + \frac{V^2}{2g} + Z = constant$$

Where Z is the potential energy, $v^2/2g$ is the kinetic energy and P/w is the pressure energy (12 marks)

Question FIVE (20 marks)

a) State and prove Pascal's Law (6 marks)

b) The velocity vector is given by; $V{=}4x^3{}_i\ {-}10x^2y_j\ {+}4t_k$ Determine the velocity and acceleration of a fluid particle at (2,1,3) at time t=1 (14 marks)