Roll No.

Total No. of Questions: 09 **Total No. of Pages: 02**

B. Tech. (ME) (Sem. 4)
FLUID MECHANICS-I
Subject Code: ME-206
Paper ID: A0810

Time: 3 Hrs. **Max. Marks: 60**

INSTRUCTIONS TO CANDIDATES:

1. **Section A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **Section B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **Section C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION A

1. Write briefly:

(i) What is capillary effect? Obtain an expression for capillary rise of a liquid.

(ii) What is the three dimensional differential equation of pressure variation in a static fluid mass?

(iii) Define metacentre and metacentric height.

(iv) Describe the different types of displacements of a fluid particle.

(v) What is streamline and what are the characteristics of stream lines?

(vi) Differentiate free and forced vortex motions.

(vii) What are distorted and undistorted models? What is the use of distorted models'?

(viii) Deduce an expression for head loss at the outlet of a pipe.

(ix) Draw the velocity distributions for (a) laminar flow and (b) turbulent flow in a pipe.

(x) Explain the use of rotameter.

SECTION B

2. A thin plate of very large area is placed in a gap of height *h* with oils of dynamic viscosity μ_1 and μ_2 on the two sides of the plate. The plate is pulled at a constant velocity *V*. Calculate position of the plate for (i) equal drag on the plate and (ii) drag on the plate is minimum .

3. An opening in a wall is covered by a vertical sluice gate. The opening is 2 m wide and 1.2 m high. On one side of the wall. a liquid of specific gravity 1.45 lies up to a height of 1.5 m above the top of the gate, whereas on the other side, water is up to the top of the gate. Find (i) the resultant force acting on the gate and position of center of pressure and (ii) the force acting at the top of the gate, which is capable of opening it. Assume that the gate is hinged at the bottom.

4. In a two-dimensional incompressible fluid flow, the velocity components are given by: u = (x - 4y) and v = -(y + 4x). Show that potential exists and determine its form.

5. A 300 mm diameter horizontal pipe carries water under a head of 20 m with a velocity of 3.5m/s. If pipe turns through an angle of 60° in the anticlockwise direction, determine the magnitude and direction of force exerted on the bend.

6. A convergent-divergent mouthpiece is fitted to the side of a water tank and is discharging freely 5.5 litres per sec under a head of 2 m. If head lost in the divergent portion is 0.1 times the velocity head at exit and the separation pressure is 2.5 m of water absolute, find the throat and exit diameters. Given, atmospheric pressure= 10.3 m of water.

SECTION C

7. Derive Euler' s equation of motion along a stream line. Hence deduce Bernoulli ' s equation.

8. Two pipes of diameter 400 mm and 200 mm, each 300 m long. When the pipes are connected in series, discharge is 0.10 m^3/s, find the loss of head. When the pipes are connected in parallel, what would be the loss of head in the system to pass the same discharge? Take coefficient of friction= 0.0075 for each pipe and coefficient of contraction= 0.65.

9. The resistance R experienced by a partially submerged body depends upon velocity V, length L, viscosity µ density ρ and acceleration due to gravity g. Using Buckingham's π-method obtain an expression for R. If resistance of a 1/8th scale ship model when tested in water at 12 m/s is 220 N, what will be the resistance in air of the modal at the corresponding speed? Given kinematic viscosity of air as 13 times that of water and density of water as 810 times that of air.