2022

FLUID MECHANICS

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **ALL** questions.*

1. a) Write in details about the following   4*5= 20

     i. Viscosity of fluid

     ii. Metacentre

     iii. Velocity Potential

     iv. Working principle of Pitot tube

2. a) Write a short note on continuity equation. Derive the governing equation (Assume the necessary).   10

    b) Prove that actual discharge over a rectangular notch is (assume the necessary)   10

$$Q = \frac{2}{3} C_d L \sqrt{2g}[H]^{3/2}$$

3. a) What do you mean by Lagrangian and Eularian methods? Write down the differences between 1D, 2D and 3D flow.   10

    b) An oil specific gravity 0.7 is flowing through a pipe of diameter 300 mm at the rate of 500 lit/s. Find the head loss due to friction and power required to maintain the flow for a length of 1000 m. Take kinematic viscosity is 0.29 stokes.   10

4. a) A submarine moves horizontally in sea and has its axis 15 m below the surface of water. A pitot tube properly placed just in front of submarine and along its axis is connected to the two limbs of a U-tube containing mercury. The difference of mercury level is found to be 170 mm. Find the speed of the submarine knowing that specific gravity of mercury is 13.6 and that of sea water is 1.026 with respect of fresh water.   10

b) A vertical sluice gate is used to cover an opening in a dam. The opening is 2 m wide and 1.2 m high. On the upstream of gate, the liquid of specific gravity 1.45, lies upto a height of 1.5 m above the top of the gate, whereas on the downstream side the water is available upto a height touching the top of gate. Find the resultant force acting on the gate and position of centre of pressure. Assume that gate is hinged at bottom.

10

5. a) A body of dimensions 1.5 m * 1.0 m * 2 m, weighs 1962 N in water. Find its weight in air. What will be its specific gravity?

10

b) What will be the x component of velocity at a point for 2D incompressible irrotational fluid motion where y component of velocity $(v) = 6xy - x^2 + y^2$?

10