Roll No. | | | | | | | | | | | | **Total No. of Pages : 02**

Total No. of Questions : 09

B.Tech. (ME) (Sem.–4)

FLUID MECHANICS-I

Subject Code : ME-206

Paper ID : [A0810]

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

INSTRUCTION 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 has to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students has to attempt any TWO questions.**

SECTION-A

1. Write briefly :

a) Distinguish between ideal and real fluids.

b) How do you determine the hydrostatic force acting on an inclined surface?

c) What is metacentric height and what is its significance with respect to stability and periodic time of oscillation of a floating body?

d) Define stream line, path line and streak line.

e) Differentiate between free and forced vortex motions.

f) What is momentum correction factor and what is its significance?

g) What is Froude's model law and under what flow situations this law is applicable?

h) Show that shear stress distribution for laminar flow in a pipe is linear.

i) Write a note on a single column manometer.

j) What is a notch and how notches are classified?

SECTION-B

2. An inverted empty bucket 300 mm in diameter and 500 mm long is forced into water until its lower edge is 4 m below the free surface. Determine the force required to maintain this position of bucket, assuming the trapped air to compress isothermally during the whole operation. The thickness of wall of bucket and its weight may be neglected. Given, atmospheric pressure = 101.325 kN/m^2.

3. For the velocity field, $V = (y^3 + 6x - 3x^2y)i + (3xy^2 - 6y - x^3)j$, check whether the flow is (i) continuous (ii) rotational or irrotational and (iii) if irrotational, find potential function.

4. For a discharge of 2.1 m^3/s of air through a pipe of area 0.093 m^2, determine the area of throat of a venturimeter as shown in **Figure 1**. Take specific weight of air as 11.96 N/m^3 and neglect losses.

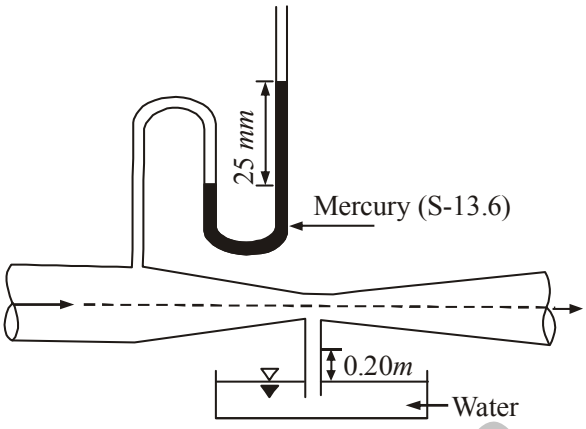

Figure 1

5. Two reservoirs are connected by a pipe which is 150 mm in diameter for the first 10 m and 250 mm in diameter for the remaining 15 m. The water surface in the upper reservoir is 7.5 m above that in the lower reservoir. Calculate the flow rate through pipe and draw HGL and TEL. Take friction factor as 0.04 for both the pipes.

6. A tank has a nozzle of diameter d_1 at a depth h_1 below the free surface. At the side opposite to this nozzle, another nozzle of diameter d_2 is attached to the tank at a depth of $2h_1$ from the free surface. Find a relationship between d_1 and d_2 if net horizontal force on the tank is zero (neglect frictional effects).

SECTION-C

7. The velocity distribution for laminar flow of a liquid in a pipe varies parabolically. The diameter of pipe is 1000 mm and the maximum velocity is 10 m/s. Draw the velocity and shear stress distribution over any cross-section of pipe. Also, calculate drag per km length of pipe surface and the power required to maintain the flow. Given, viscosity of liquid = 2 *cP*.

8. The power *P* developed by a hydraulic turbine is a function of: diameter *D*, width *B*, rotational speed *N* of runner, operating head H, mass density p, viscosity μ of water and gravitational acceleration *g*. Derive a relationship among the variables using method of dimensional analysis.

9. A vertical cylindrical tank of diameter 1.5 m has a 50 mm diameter sharp edged orifice at its bottom. If water enters the tank at a constant rate of 10 litres per sec, find the depth of water above the orifice when the level of water in the tank becomes steady. Thereafter, the water runs into the tank at a constant rate of 15 litres per sec, calculate the rate of rise in water level when the water level has reached 4 m above the orifice. Given, coefficient of discharge = 0.65.