Printed Pages : 4

ECE-301

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 100305

Roll No. | | | | | | | | | |

B. Tech.

(SEM. III) (ODD SEM.)

THEORY EXAMINATION, 2014-15

FLUID MECHANICS

Time : 3 Hours] [Total Marks : 100

Note : (1) Attempt all questions. Assume any missing data, suitably if required.

(2) Marks and number of questions to be attempted from the section is mentioned before each section.

1 Attempt any four parts of the following : **4×5=20**

(a) Define different physical properties of fluids.

(b) The pressure of a liquid is increased from 60 N/cm^2 to 120 N/cm^2 and volume decreased 0.2 percent. Determine the bulk modulus of elasticity.

(c) A cubical block weighing 5N and having a 40 cm edge is allowed to slide down an inclined plane surface making an angle of 30° with the horizontal on which there is a uniform layer of oil 0.004 cm thick. If the expected steady state velocity of the block is 10.5 cm/sec, determine the viscosity of the oil.

(d) Discuss limitations of Bernoulli's theorem.

(e) Prove that centre of buoyancy is always below than centroid of a vertical or inclined surfaces.

(f) Two large tanks containing water have smoothly contoured orifices (openings) of equal area (figure 1). A jet of water issues from the orifice of the left tank. Assume that the flow is uniform and viscous losses are negligible. The jet impinges on a vertical flat plate covering the opening of the right tank. Choose an appropriate CV to determine the minimum value of the height h required to keep the plate in place over the orifice of the right tank.

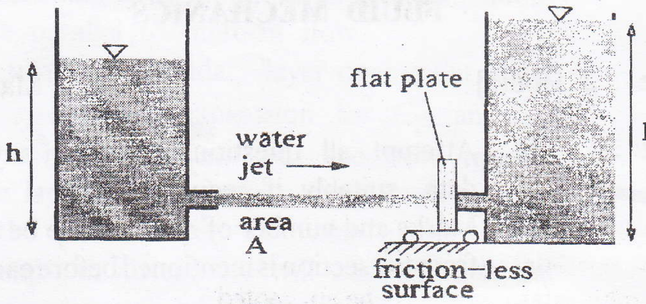

Fig. 1

2 Attempt any **four** parts of the following : 4×5=20

(a) Define and distinguish between :
   (i) Steady and unsteady flow
   (ii) Uniform and non-uniform flow.

(b) If $\psi = 3xy$, find x and y components of velocity at (1, 3) and (3, 3). Determine the discharge between streamlines passing through these points.

(c) The velocity potential for a flow are given by $\phi = x^2 - y^2$. Show that the condition of continuity and irrotational flow are satisfied.

(d) What is flow-net ? List the limitations of flow-net. Discuss any one method of drawing flow-net.

(e) Derive continuity equation for 3-D steady irrotational flow of fluid.

(f) Define acceleration of a fluid particle. Discuss transport and local tangential acceleration with example.

3 Attempt any **two** parts of the following : **2×10=20**

(a) The water is flowing through a pipe having diameter 200 mm and 100 mm at section 1-1 and section 2-2 respectively. The rate of flow through the pipe is 35 lit/sec. The section 1-1 is 6 m above datum and section 2-2 is 4m above datum. If the pressure at section 1-1 is 400 kN/m^2, find the intensity of pressure at section 2-2.

(b) Define coefficient of discharge, coefficient of contraction and coefficient of velocity. What is the relation among them ?

(c) A horizontal venture-meter with inlet and throat diameters 30 cm and 15 cm respectively is used to measure the flow of water. The reading of differential manometer connected to the inlet and the throat is 20 cm of mercury. Determine the rate of flow. Take $c_d = 0.98$.

4 Attempt any **two** parts of the following : **2×10=20**

(a) For laminar flow between two parallel fixed plates, derive expression for velocity and shear stress distribution.

(b) (i) Explain the Prandtl mixing length theory for turbulent shear stress and find the expression for velocity profile. What is velocity defect ?

(ii) What do you understand by hydro-dynamically smooth and rough boundaries ?

(c) Derive and expression for head loss due to sudden contraction of a pipe.

5 Attempt any two parts of the following : **2×10=20**

(a) What do you understand by the boundary layer ? Explain with sketch the development of boundary layer along a thin flat and smooth plate parallel to uniform flow.

(b) For turbulent boundary layer over a flat plate, one can derive expression for C_D and δ. We normally assume that the flow transits from laminar to turbulent at the leading edge of the plate. Here, we want to relax this assumption; instead we will consider that the transition occurs where $Re_x = Re_{crit} = 5\times10^5$. Recall that for turbulent flow

$$\frac{V_x}{V_0} = \left[\frac{y}{\delta}\right]^{1/7} ; \; C_f = \frac{0.045}{(Re_\delta)^{1/4}}$$ and for laminar

flow $\frac{\delta}{x} = \frac{5}{\sqrt{Re_x}}$

Apply the momentum integral equation and derive expressions for C_D and δ.

(c) Consider laminar flow over a flat plate. Find displacement thickness and momentum thickness for a sinusoidal velocity profile.