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10ME/AU36B

Third Semester B.E. Degree Examination, Dec.2013/Jan.2014
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define the following terms and mention their SI units:
   i) Capillarity.
   ii) Dynamic viscosity.
   iii) Weight density.
   iv) Bulk modulus. **(06 Marks)**

b. Explain the effect of temperature variation on viscosity of liquids and gasses. **(04 Marks)**

c. Two large plane surfaces are 2.4cm apart. The space between the surface is filled with glycrene. What force is required to drag a very thin plate of surface area 0.5 square meters between the two large plane surfaces at a speed of 0.6 m/s, if the thin plate is at a distance of 0.8cm from one of the plane surface? Take $\mu = 8.1 \times 10^{-1}$ N-s/m^2. **(07 Marks)**

d. Derive an expression for surface tension of a soap bubble. **(03 Marks)**

2 a. Define the following:
   i) Gauge pressure.
   ii) Vaccum pressure.
   iii) Centre of pressure.
   iv) Hydrostatic law. **(08 Marks)**

b. A Caisson for closing the entrance to dry dock is of trapezoidal form 16m wide at the top and 10m wide at the bottom and 6m deep. Find the total pressure and centre of pressure on the Caisson if the water on the outside is just level with the top and dock is empty. **(08 Marks)**

c. What is a manometer? How they are classified? **(04 Marks)**

3 a. If for a two-dimensional potential flow, the velocity potential is given by $\phi = x(2y - 1)$, determine the velocity at point P(4, 5). Determine also the value of stream function at the point P. **(10 Marks)**

b. Derive an expression for metacentric height of a floating body using analytical method. **(10 Marks)**

4 a. Derive Euler's equation of motion for an ideal gas. **(08 Marks)**

b. State Bernoulli's theorem for steady flow of an incompressible fluid. **(02 Marks)**

c. A pipe line carrying oil of specific gravity 0.87, changes in diameter from 200mm diameter at a position A to 500mm diameter at a position B which is 4 meters at a higher level if the pressures at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 litres/s determine loss of head and direction of flow. **(10 Marks)**

PART – B

5 a. Derive an expression for the discharge over a triangular notch in terms of water over the crest of the notch. **(08 Marks)**

b. A 30cm × 15cm venturimeter is provided in a vertical pipe line carrying oil of specific gravity 0.9, the flow being upwards. The difference in elevation of the throat section and entrance section of the venturimeter is 30cm. The differential U-tube mercury manometer shows a gauge deflection of 25cm. Calculate: i) The discharge of oil; ii) the pressure difference between the entrance section and the throat section. Take coefficient of meter as 0.98 and specific gravity of mercury as 13.6. **(09 Marks)**

c. What are the methods of dimensional analysis? Describe Buckingham's π-theorem for dimensional analysis. **(03 Marks)**

6 a. Derive an expression for the loss of head due to sudden enlargement of a pipe. **(10 Marks)**

b. Determine the difference in the elevations between the water surfaces in the two tanks which are connected by a horizontal pipe of diameter 300mm and length 400m. The rate of flow through the pipe is 300 litres/sec. Consider all losses and take f = 0.008. Also draw HGL and TEL. **(10 Marks)**

7 a. Derive an expression for Hagen Poiseullie formulae. **(10 Marks)**

b. An oil of viscosity 0.1 N-s/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 50mm and length 300m. The rate of flow of fluid through the pipe is 3.5 litres/sec. Find the pressure drop in a length of 300m and also the shear stress at the pipe wall. **(10 Marks)**

8 a. Define terms: i) Drag; ii) Lift; iii) Displacement thickness; iv) Boundary layer thickness; v) Energy thickness. **(10 Marks)**

b. For the velocity profile for laminar boundary layer flows given as $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$, find an expression for boundary layer thickness (δ). Shear stress (τ_0) interms of Reynold's number. **(10 Marks)**

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